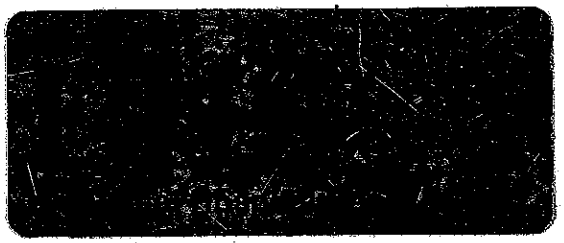

Capnocheck® Plus

Service Manual

BCI International
W238 N1650 Rockwood Drive
Waukesha, WI 53188-1199

Catalog Number 1873
June 12, 1997 Version 2

Chapter 1: Introduction

Warranty & Service Information

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NOTE: Shipments received without a CSR number will be returned to sender.

If you need to ship the device, pack the device and its accessories carefully to prevent shipping damage. All accessories should accompany the device.

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About This Manual

This manual contains circuit descriptions, voltage and waveform test points, detailed parts lists, and circuit diagrams for the capnometer. It is intended for persons trained in service, maintenance, and repair of modern medical equipment. Thorough knowledge of this equipment's operation is required before attempting to repair this equipment.

⚠ Warnings, Cautions, and Notes

KEYWORD	DEFINITION
WARNING	Tells you about something that could hurt the patient or hurt the operator.
CAUTION	Tells you about something that could damage the monitor.
NOTE	Tells you other important information.

Warnings

WARNING: Federal law (USA) restricts the use or sale of this device by, or on the order of, a physician.

WARNING: Do not use this device in the presence of flammable anesthetics.

WARNING: Do not autoclave, ethylene oxide sterilize, or immerse in liquid. Unplug before cleaning or disinfecting.

WARNING: ELECTRICAL SHOCK HAZARD when cover is removed. Do not remove covers. Refer servicing to qualified personnel.

WARNING: Use only SpO_2 probes supplied with, or specifically intended for use with, this device.

WARNING: Do not use this device in the presence of magnetic resonance imaging (MR or MRI) equipment.

WARNING: Do not plug the monitor into an outlet controlled by a wall switch.

WARNING: This device must be used in conjunction with clinical signs and symptoms. This device is only intended to be an adjunct in patient assessment.

WARNING: In the event that earth ground integrity is lost, the performance of this device and/or other devices nearby may be affected due to excessive RF emissions.

WARNING: Reposition the SpO_2 probe at least once every four (4) hours or as needed to allow the patient's skin to respire.

WARNING: When attaching SpO_2 probes with Microfoam® [1] tape, do not stretch the tape or attach the tape too tightly. Tape applied too tightly may cause inaccurate readings and blisters on the patient's skin (lack of skin respiration, not heat, causes the blisters).

WARNING: The displayed message FiO_2 Ref Err indicates a factory calibration setting is incorrect. Contact your authorized repair center.

WARNING: Each FiO_2 cell has different output characteristics; changing the FiO_2 cell without calibrating the monitor can result in incorrect displayed FiO_2 values. The incorrect values are unpredictable in both magnitude and direction, possibly resulting in hypoxic FiO_2 gas mixtures while displaying high FiO_2 values. It is your responsibility to properly calibrate the monitor after changing FiO_2 cells.

WARNING: When connecting this monitor to any instrument, verify proper operation before clinical use. Refer to the instrument's user manual for full instructions. Accessory equipment connected to the monitor's data interface must be certified according to the respective IEC standards, i.e., IEC 950 for data-processing equipment or IEC 601-1 for electromedical equipment. All

[1] Microfoam® is a registered trademark of the 3M Company.

combinations of equipment must be in compliance with IEC 601-1-1 systems requirements. Anyone connecting additional equipment to the signal input port or signal output port configures a medical system, and, therefore, is responsible that the system complies with the requirements of the system standard IEC 601-1-1.

Cautions

CAUTION: Ensure the device's AC rating is correct for the AC voltage at your installation site before using the monitor. The monitor's AC rating is shown on the external power supply. If the rating is not correct, do not use the monitor; contact BCI International's service department for help.

CAUTION: This device is intended for use by persons trained in professional health care. The operator must be thoroughly familiar with the information in this manual before using the monitor.

CAUTION: Do not allow water or any other liquid to spill onto the monitor. Unplug the external power supply from the monitor before cleaning or disinfecting the monitor.

CAUTION: Pressing front panel keys with sharp or pointed instruments may permanently damage the keypad. Press front panel keys only with your finger.

CAUTION: Do not disassemble unit, not user serviceable. Refer to qualified service personnel.

Notes

NOTE: Dyes introduced into the bloodstream, such as methylene blue, indocyanine green, indigo carmine, and fluorescein, may cause an inability to determine accurate SpO_2 readings.

NOTE: Any condition that restricts blood flow, such as use of a blood pressure cuff or extremes in systemic vascular resistance, may cause an inability to determine accurate pulse and SpO_2 readings.

NOTE: Operation of this device may be adversely affected in the presence of strong EM or RF sources, such as electrosurgery equipment.

NOTE: Operation of this device may be adversely affected in the presence of computed tomograph (CT) equipment.

NOTE: Significant levels of dysfunctional hemoglobins, such as carboxyhemoglobin or methemoglobin, will affect the accuracy of the SpO_2 measurement.

NOTE: SpO_2 measurements may be adversely affected in the presence of high ambient light. If necessary, shield the probe area (with a surgical towel, for example).

NOTE: Remove fingernail polish or false fingernails before applying SpO_2 probes. Fingernail polish or false fingernails may cause inaccurate SpO_2 readings.

NOTE: Store the FiO_2 cell as shipped in its protective wrapping, until it is ready to use. This maximizes the FiO_2 cell's shelf life.

NOTE: Prolong FiO_2 cell life by avoiding high O_2 and CO_2 concentrations when it is not in use.

NOTE: FiO_2 Humidity and Pressure Compensation:

Humidity (i.e. water vapor) is not an interferent, and does not affect the FiO_2 cell accuracy. Water vapor behaves as any diluting gas and reduces the oxygen partial pressure; the FiO_2 cell will correctly indicate the reduced percent FiO_2. However when calibrating the FiO_2 cell, the humidity of the calibration gas reduces the oxygen partial pressure, it is for this reason that calibration gas must be dry. For example, at 37°C, water vapor pressure (PH2O) is 47 mmHg, reducing the oxygen partial pressure of 100% oxygen to (760-47) 713 mmHg and results in an oxygen concentration of 94%. If the sensor must be calibrated with humidified oxygen, then if the calibration gas is 100% humidified, the following equation provides a correction factor that must be applied to all FiO_2 readings:

$$C_{H2O} = \frac{P_{cal} - P_{H2O}}{P_{cal}} \qquad (1)$$

In addition, if the pressure of the calibrating gas (Pcal) is not 760 mmHg, then a further correction can be made according to the following:

$$C_{cal} = \frac{P_{cal}}{760\ mmHg} \qquad (2)$$

The FiO_2 cell manufacturer specifies an operating pressure (Psys) range of +/- 200 mmHg (+/- 4 psig). The FiO_2 cell response is proportional to oxygen partial pressure, the result being that indicated FiO_2 can be corrected for the difference in pressure between the operating system and the calibrating system pressure. The correction can be obtained from the following equation:

$$C_{sys} = \frac{760\ mmHg}{P_{sys}} \qquad (3)$$

The final result is that actual FiO_2 can be calculated from indicated FiO_2 by combining equations 1, 2 and 3:

$$FiO_2\ (actual) = FiO_2\ (indicated) * C_{H2O} * C_{cal} * C_{sys} \qquad (4)$$

Pneumatics Cleaning

Cleaning of the pneumatics system is only recommended if done by qualified service technicians. Cleaning of the pneumatics is generally not required if proper filter is used at all times. However, improper use of the device or use under very harsh conditions may warrant periodic cleaning.

The Pneumatics consists of five main parts:

- Tubing
- Sample cell (i.e. CO_2 bench)
- Diaphragm pump
- Three-way autozero valve
- Pressure transducer

Each of the above parts should be cleaned independent of each other. For example, all tubing should be disconnected from components before cleaning. Use one of the following procedures, whichever is most appropriate:

Procedure:

For tubing and diaphragm pump:

1. Pass a mild detergent through to remove any oily residue or contaminants.
2. Flush with distilled water to remove the detergent.
3. Flush with absolute ethanol to remove the moisture.
4. Flush with dry gas to evaporate ethanol and dry the component thoroughly.
5. Make sure components are dry before reassembling.

Three-way autozero valve:

1. Flush with dry gas. Do not flush with alcohol or water.

Pressure transducer and CO_2 bench:

1. If contaminated it must be replaced by a qualified service technician.

After the device is reassembled, make sure to check for proper operation and flow rate. If the device does not function as specified refer to qualified service technicians for repair or replacement of pneumatics components.

Chapter 2: Field Service Menu

Some factory service menu options can also be set through the Field Service menu on the monitor. To access the field service menu, power up the unit and listen for the beep. After the beep, use two hands to momentarily press the **WAVE/TREND** and **MENU/ENTER** keys at the same time. When the power up screen goes away, press **MENU/ENTER** to display the main menu. Press **MENU/ENTER** again to select "SERVICE", which is the first item in this menu.

Field Service Menu

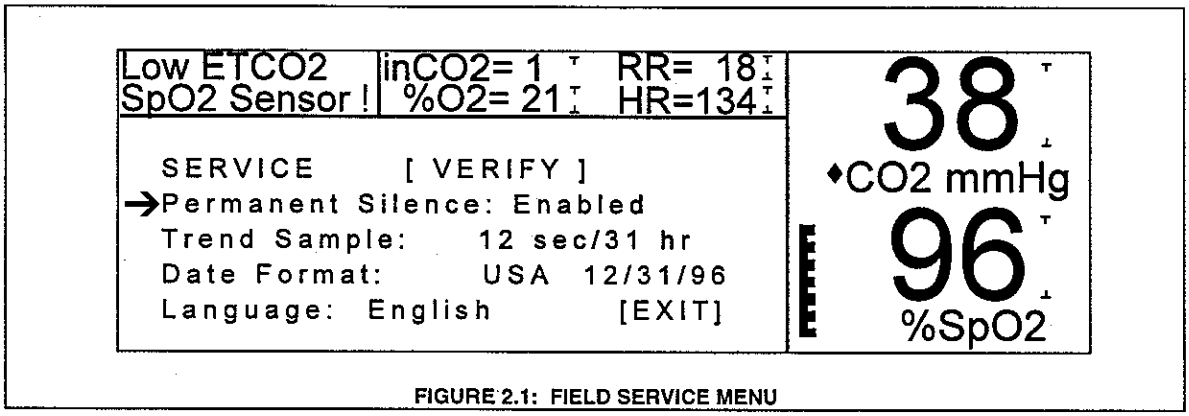


FIGURE 2.1: FIELD SERVICE MENU

VERIFY — This takes you to another menu which shows internal capnograph parameters.

Permanent Silence — "Enabled" means alarms can be silenced indefinitely by pressing and holding the **ALARM SILENCE** key for 3 seconds. "Disabled" means indefinite alarm silence is not allowed. In this case, only 2-minute alarm silence is available.

Trend Sample — This selects the basic sample time for trend data record storage. The sample time determines the maximum number of records stored and consequently the maximum storage time. "12 sec/31 hrs" means 12 second sample time for 31 hours maximum storage. "4 sec/10 hrs" means 4 second sample time for 10 hours maximum storage.

NOTE: If the Trend Sample time is changed, the monitor will turn off after quitting the Service menu. This forces the monitor to reconfigure memory at power up.

Date Format "USA" selects a date format of month/day/year. "EURO" selects a European date: day/month/year.

Language Selects the language for all displayed text: English, French, German, Spanish, or Italian.

NOTE: When the language is changed, you will not see the display in that language until after you exit the Service menu. The monitor will power down and the new language is loaded at power up.

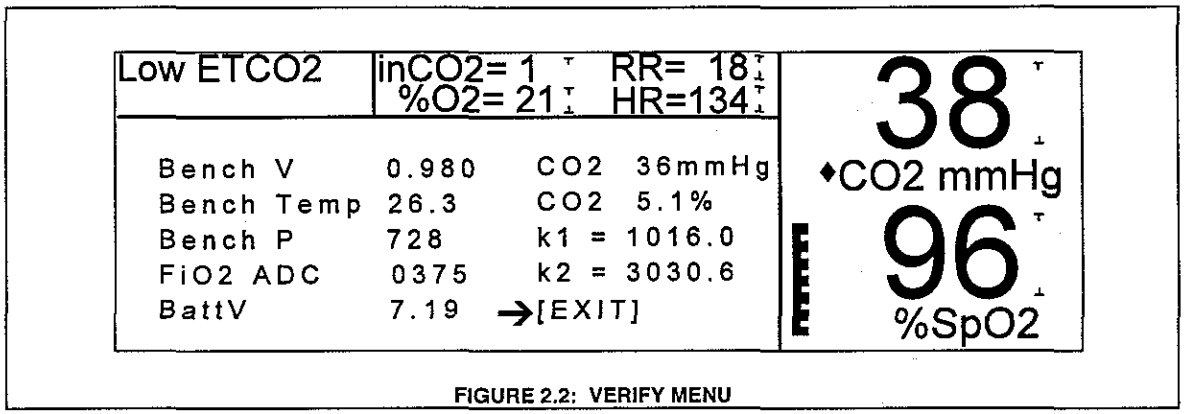


FIGURE 2.2: VERIFY MENU

Bench V The voltage on the output of the CO_2 sensor is proportional to the CO_2 concentration. During troubleshooting this value can be used to verify whether the sensor is operational. If a different amount of CO_2 is passed through the system, the "Bench V" value will vary: the higher the CO_2 value, the lower the "Bench V." Note: All benches are slightly different. Factory calibration compensates for the difference. Use "Bench V" as a relative number only.

Bench Temp The temperature of the CO_2 sensor, in °C, which is used by the algorithm to compensate for temperature dependency of the sensor. Because of the heating element inside the bench, expect the "Bench Temp" to be a few degrees higher than ambient temperature.

Bench P The pressure inside the bench chamber (in mmHg). It is measured by an external (from CO_2 bench) pressure sensor. When the pump is running, anticipate this value to be below the ambient pressure.

FiO_2 ADC	The FiO_2 Analog-to-Digital converter reading in counts. When the FiO_2 sensor is not plugged in, this reading must be close to zero. If the FiO_2 sensor is replaced with a short, this value is around 350 counts. If the FiO_2 sensor is plugged in, this value will increase with an increase in O_2 concentration.
Batt V	The voltage on the battery terminals as seen by the system Analog-to-Digital converter. If the battery is charging, this voltage will increase to more than 7 V. If the unit is running on the battery, this voltage will slowly drop from 6 to 5 V.
CO_2 mmHg	Current CO_2 reading in mmHg.
CO_2 %	Current CO_2 reading in percent. For example, if 10% CO_2 gas is supplied, expect to see a value in the range of 9.6% to 10.4%.
k1, k2	Calibration constants. These numbers reflect the CO_2 curve: CO_2 concentration vs. CO_2 sensor voltage. If a low/high cal has been done, expect to see slightly different k1 and k2 values.

Chapter 3: Capnocheck® Plus Circuit Description

Battery Charger

The battery Charger is built around charging controller U17. This IC controls the charging current in both fast charge and trickle charge modes, switching from fast charge mode to trickle charge mode when the end of charge condition has been reached. It senses charging current by measuring the voltage drop across current sense resistor R63. Thermistors T3, T4 and the thermistor inside battery pack in combination with resistors R59..R61 provide temperature control, preventing fast charge in very cold or very hot environments, and, also, preventing battery from overheating during fast charge. U17 controls the switch mode voltage regulator U18 using current mirror Q8-Q9. This completes the feedback loop.

The charging indicator circuitry is built around multivibrator Q12-Q13. Depending on the FAST control signal (U17, pin 8), the green LED either stays lit (in trickle charge mode) or blinks with a very low duty factor (in the fast charge mode).

System Power Supply and ON/OFF Circuitry.

The system +5VDC power supply is built around a low drop voltage regulator IC U20. MOSFET transistor Q11 is used as a controlled element. Isolated power for the Oximeter Slave Board is generated by the DC-DC voltage converter built around U21, Q14 and transformer T5. The clock signal for the converter is the microprocessor clock divided by the frequency divider inside U4.

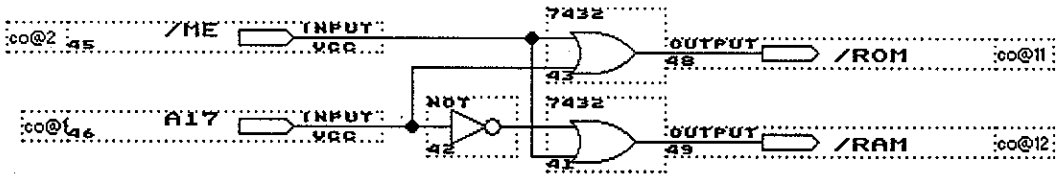
The Power ON/OFF circuitry is built using the voltage comparator located inside the "watch dog timer" IC U19. When the STNBY/ON key is pressed, it pulls the base of PNP transistor Q10 to "ground" through resistor R67. Transistor Q10 pulls up EN (enable) input of voltage regulator U20 turning system +5V on. From then the high voltage level on EN input is maintained by the VCC voltage through resistors R68 and R69 until power is off.

There are several conditions which can power down the Monitor. If the STNBY/ON key is pressed, the microprocessor generates a /HALT signal which pulls down the PFI input of the voltage comparator inside U19. The output open drain signal, /PFO, goes low and turns off U20 by pulling EN low. The other condition for turning the Monitor off is a low battery. The battery voltage is measured by the resistor divider R65-R65. If this voltage is lower than the 1.25VDC threshold of the internal comparator U19, the output signal, /PFO, goes low.

In addition, the output of the resistor divider is connected to the Analog-to-Digital converter, and is read by the microprocessor to give an early warning about low battery condition.

Microprocessor Section and Address Decoders

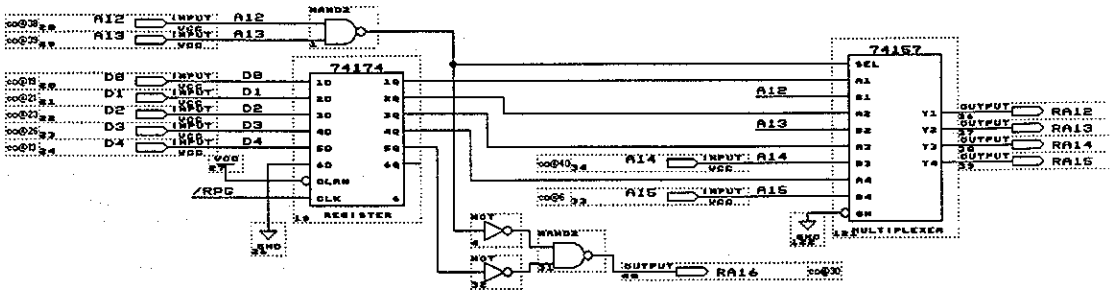
Microprocessor U1 is a Zilog Z180. Its address and data buses are connected to the One Time Programmable Read Only Memory (OTP ROM) U2 and Random Access Memory (RAM) U3. A Memory Address Decoder is implemented in the Field Programmable Gate Array (FPGA) U4. The following drawing shows the Memory Address Decoder section of FPGA:



The memory address map is shown in the following table:

Device	Address Space
OTP ROM	0 .. 1FFFF
RAM	20000 .. 23FFF

FPGA U4 also includes a RAM Page Selector used to split the whole RAM area into pages, which can be accessed by the microprocessor. The corresponding section of FPGA is shown on the following drawing:

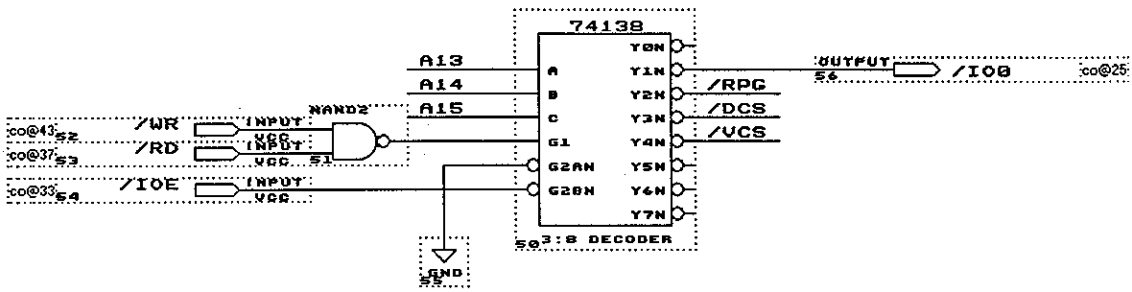


The Page Selector includes a Page Register - a five bit output port, in which the microprocessor stores the page number. Hence, a total of 32 pages exists. The total RAM size is 128 kbytes, each page is 4 kbytes long. The Page Selector is configured such that the first three pages can exist as "solid" 12 kbytes of memory, which allows a large amount of data to be located in continuous memory.

RAM Address Space	RAM Page
20000 .. 20FFF	Page 0
21000 .. 21FFF	Page1
22000 .. 22FFF	Page 2
23000 .. 23FFF	Pages 0..31

By writing a page number into the Page Register, address space 23000 .. 23FFF can be assigned to any of 32 pages. As seen from the table, RAM pages 0, 1 and 2 can be either part of 12kbytes of continuous address space, or can be selected together with other pages to reside in the top 4kbytes (address 23000 .. 23FFF). For practical reasons, they are always accessed as continuous memory.

The address decoder for the Input / Output Interface devices is implemented in FPGA U4. The corresponding section of FPGA is shown on the following drawing:



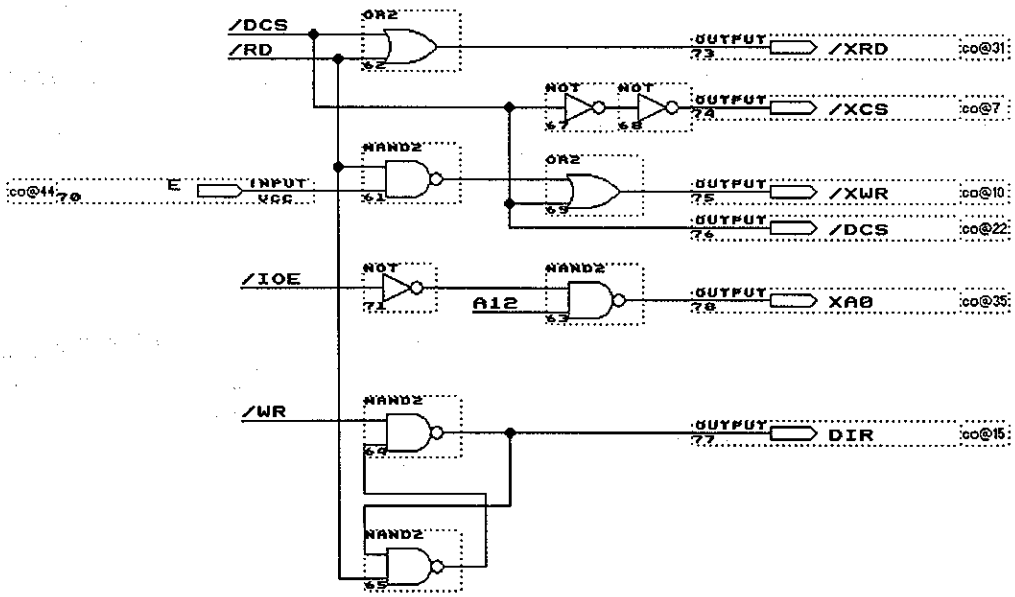
The I/O address space is divided according to the following table:

I/O Address Space	Device
0 .. 1FFF	Used by Z180 for internal registers
2000 .. 3FFF	External I/O
4000 .. 5FFF	RAM Page Register
6000 .. 7FFF	Display Select
8000 .. 9FFF	Volume Control Select
A000 .. FFFF	Not used

External I/O is the only I/O select available outside the FPGA, all others are used inside the chip.

Display Controller.

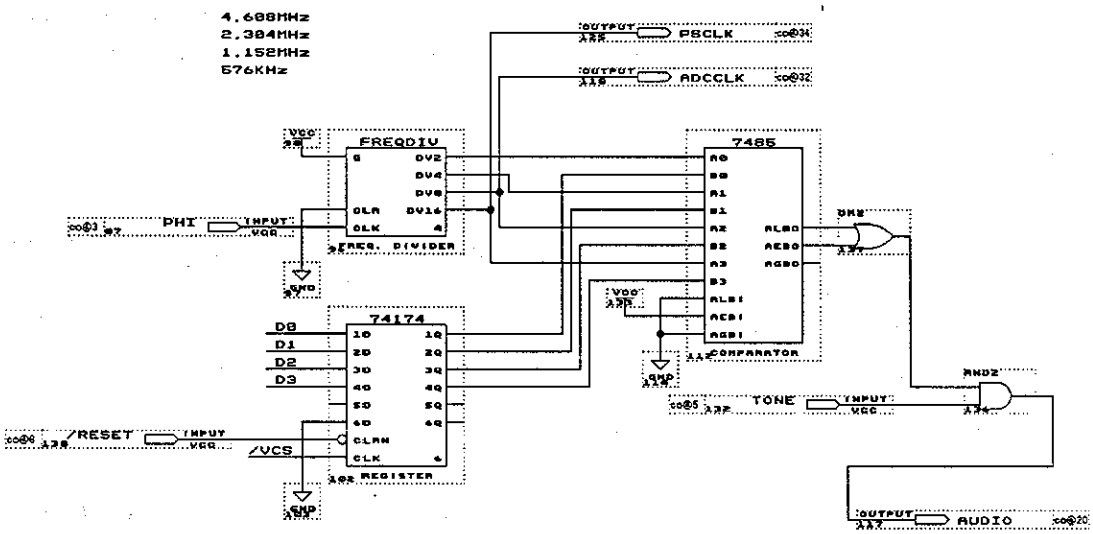
Vacuum Fluorescent Display Module is used in the Monitor to display graphical and numerical information. The Display has its own controller board which accepts data in parallel 8-bit format in the form of Commands (signal A0 on the Display communication connector J2 is log. 1) and Data (signal A0 on the Display communication connector J2 is log. 0). Bi-directional data bus buffer U5 is used to pass data from the Display board to the microprocessor and from the microprocessor to the Display Board. All signals to control U5 and Display Board are generated inside FPGA U4:



The timing diagrams of the Display Write and Read Cycles are shown on the schematic. From the microprocessor's "point of view", the Display Board represents a general purpose I/O device, controlled using signals /CS - select, /WR - write, /RD - read and A0 - Command/Data select. Signals /DCS and DIR control the bi-directional buffer and prevent any possible bus conflicts between Display Board, buffer and microprocessor.

Speaker Volume Controller.

Speaker Volume Controller is located in FPGA U4. The corresponding fragment of FPGA is shown on the following drawing:



The volume control code is stored by the microprocessor into a four bit parallel register. Code 0 corresponds to the lowest volume, code F - to the highest. Volume control circuitry inside FPGA also includes a binary counter which divides the microprocessor clock frequency. The by-products of this counter are the clock frequency for the Analog - to - Digital Converter (signal ADCCLK) and for the DC-DC converter (signal PSCLK). The binary code from the divider is compared with the number stored in the four bit parallel register. The result of the comparison is the pulse train with a variable duty cycle which depends on the number stored in the parallel register. If the number equals zero, the duty factor is 1/16, if the number equals F, the duty factor is 1, or the output represents constant logical "one". Then the signal is gated with the TONE signal - audio frequency signal generated by the microprocessor. The external R-C filter converts the resulting pulse train into an audio frequency signal, the amplitude of which is directly proportional to the number stored in the parallel register. Hence, a total of 16 levels of volume, plus OFF, can be achieved with this circuitry.

External I/O's

External I/O's include an 8 bit input buffer and a 14 bit output register. The input buffer allows the microprocessor to read keyboard signals and serial data streams coming from the Real Time Clock (RTC) IC, Analog - to - Digital Converter (ADC) and CO2 Bench internal Electrically Erasable Programmable Read Only Memory (EEPROM). The output register allows the microprocessor to control LED's, keyboard strobe signals and all other peripheral devices.

Pump and Valve Control.

The pump and valve are controlled by the microprocessor through External *I/O* output register. Dual MOSFET Q4 is used to turn pump and valve on and off.

Speaker Driver.

The Speaker Driver is built around operational amplifier U12A. It controls the speaker driving transistor Q5. The input signal AUDIO generated by FPGA is filtered by passive R-C filter R25-C19-R26 to restore the DC component of the AUDIO signal, which is then amplified by U12A and Q5 circuitry and is passed to the speaker through connector J6.

Analog Outputs Controller.

The Analog Outputs Controller is built around Digital - to - Analog converter (DAC) U9. IC U9 contains three independent 8-bit (256 voltage steps) DAC's inside, which are used for analog output channels A, B and C. U13A, with associated resistors, converts the 2.5VDC voltage reference output into a 1VDC output used as a reference signal for analog outputs. The output of the first internal DAC (signal OUTA) is connected through an ESD protection network R33-C27 to the output DB25 connector. The outputs of two other internal DAC's are not internally buffered like the output of the first internal DAC. That is why two voltage followers U12B and U12C are used as buffers between DAC and output connector. The DAC is controlled by the microprocessor using synchronous serial communications.

RS232 Controller.

The RS232 Controller is built around IC U10, which is used to convert CMOS voltage levels into RS232 bipolar voltage levels. U10 is connected directly to the output DB25 connector through ferrite beads.

Real Time Clock.

The Real Time Clock U11 is a system "watch". It is powered from either the main +5VDC or the Lithium Battery BT1 when the Monitor is turned off. Switching between main and battery power is performed by the watch dog timer U19. Crystal X2 is directly connected to U11 to provide a very accurate time reference. The Real Time Clock IC can be set and read by the microprocessor through serial communications. The data line coming to U11 is by-directional, and is used for both data in and out. Transistor Q6 and resistor R36 convert two separate input and output serial data signals into one bi-directional data signal using open collector with passive pull up approach. Diode D11 is used for ESD protection.

Watch Dog Timer

Watch Dog Timer IC U19 is used to perform the following three functions:

- Its internal comparator is used in the ON/OFF circuitry (see earlier);
- It switches V-RAM from the main +5VDC power to 3VDC Lithium Battery BT1, providing power for both RAM and the Real Time Clock;
- It resets the microprocessor at power up;
- It resets the microprocessor if signal WDI is not generated for a long time, which indicates that microprocessor was upset by ESD discharge and is not running properly.

Analog Section

The analog section is used to acquire data from sensors and read battery voltage. Analog - to - Digital Converter (ADC) U14 can convert up to eight input voltages in the range of 0 to VREF. Signal VREF is generated by the voltage reference U16 and equals 2.50VDC. ADC communicates to the microprocessor serially.

CO_2 Sensor

The CO_2 Sensor (or CO_2 Bench) generates two output voltages. One indicates CO_2 concentration, and the other is proportional to the CO_2 detector's temperature. The light source inside the Bench is precisely controlled by the current sink circuitry built around U15B and the 0.1% accurate resistor, R45. The voltage across R45 is maintained equal to VREF, hence the current through resistor is very stable and accurate.

The voltage level from the Bench, which indicates CO_2 concentration, comes to the gain-offset stage built around U15A and R48. It converts the Bench voltage level into an ADC compatible voltage range. The gain - offset equation is:

$$Vout = 2.77 * Vin - 1.646V$$

Another function of U15A in combination with R82, R81, C89 and C88 is to create a low pass filter to reduce out-of-range noise.

A voltage level proportional to the CO_2 detector's temperature comes directly to the input of ADC. It does not require any amplification or level shifting.

Pressure Sensor.

The Pressure Sensor is used in the Monitor to measure Bench pressure and ambient pressure when the pump is turned off. An integrated temperature compensated pressure sensor MP1 is used. Its output voltage level is directly proportional to the absolute pressure. To convert its output voltage into 0..2.5VDC ADC input range, precise divider R48 is used.

FiO_2 Sensor.

The FiO_2 sensor represents a millivolt range voltage source. U13B with associated components is used to amplify the millivolt range sensor output voltage into a 0..2.5VDC ADC input range. If the sensor is not plugged in, the input of the operational amplifier U13B is at "ground" level, which indicates "no sensor" condition. If the sensor is plugged in, the offset voltage from the resistor divider R87-R88 shifts the input voltage high, indicating "sensor" condition. The offset value is acquired and stored during the factory calibration process.

Battery Voltage Level.

The battery voltage comes to the analog section through resistor R50 and is buffered by U12D. Then it is directly digitized by the ADC. This information is used by the microprocessor to generate an early low battery warning.

Signal Dictionary

This section lists, in alphabetical order, the signal names used on the schematics. The signal's origin, destination, and purpose are described.

Main Board

SIGNAL	DESCRIPTION
A0-A17	A0 through A17 are the microprocessor's address lines. A0-A17 are used to address the RAM, PROM, and I/O ports.
A18 = TONE	Microprocessor output A18 (TOUT) is configured as a timer output and controls the tone of the optional pulse beep speaker.
ACH0-ACH2	Three analog output signals.
ADCCLK	ADC clock frequency of 1.152MHZ.
/ADCS	Signal used to select ADC.
ADDI	Synchronous communication input data line, same as DI
ADDO	Synchronous communication ADC output data line
ANA+5	The +5 volt power supply VCC is filtered to produce ANA+5. ANA+5 powers the analog circuitry.
AUDIO	Pulse-width-modulated signal representing audio TONE frequency used to control speaker driver and generated by U4.
BATT	Signal used to monitor battery voltage, equals to VBATT in magnitude.
BTEMP	CO2 bench output voltage proportional to the bench temperature.
/BUSY	Return signal from the external printer or computer. Indicates that remote device is not ready to receive data from the Monitor. is converted to CTS0 signal by U10.
/CAL	Signal which initializes ADC self-calibration cycle.
CKS	CKS is the microprocessor's high-speed, synchronous serial output clock signal.
/CONVST	Signal which initializes ADC conversion cycle.
CO2	Voltage generated by the gain-offset stage U15A indicating CO2 concentration.
/DACS	Signal used to select DAC chip U9.
D0-D7	D0 through D7 are the microprocessor's data lines. The data lines are routed to RAM, PROM and peripheral devices.
DI	Synchronous communication input data line, same as ADDI
DO	Synchronous communication output data line
DIR, /DCS	Signals used to control bi-directional display communication buffer U5.
EECLK	CO2 bench internal EEPROM clock signal.
/EECS	Signal to select CO2 bench internal EEPROM chip.
FAST	Log. 0 indicates fast battery charging mode.

SIGNAL	DESCRIPTION
FIO2	Voltage proportional to FiO2 concentration.
/HALT	Signal used by microprocessor to turn power off.
/IO0	Strobe to U6 to read input data and to U7 and U8 to latch output data.
ON-STBY	Line connected to the O/I key.
PFI, /PFO	Power fail input and output signals, used to shut down the monitor if battery is too low.
PWR-LED	Used to light green "CHARGE" LED on the keypad.
PSCLK	Clock frequency 576KHZ used for Isolated Power Supply
PHI	Clock signal generated by microprocessor.
PRESS	Voltage proportional to the CO2 cell absolute pressure. Equals to the output of the pressure sensor divided by two.
PUMP	Signal to turn pump on and off.
/RD, /WR, /ME, E /IOE	Signals used by microprocessor to control memory and peripheral devices.
/RESET	Microprocessor and peripheral devices reset signal.
/RAM	Signal used to enable RAM
RA12-RA16	Address lines to select RAM page.
/ROM	Signal used to enables ROM
/RTCS	Signal used to select Real Time Clock chip.
RXS	RXS is the microprocessor's high-speed, synchronous serial input receiving data signal.
STBY	Input signal indicating that I/O key was pressed.
SCLK	Synchronous communication clock line.
TX0, RX0, CTS0	Asynchronous serial communication signals used to control external optional printer.
TX1, RX1	Asynchronous serial communication signals used to communicate with Little Oximeter Board.
TXS	TXS is the microprocessor's high-speed, synchronous serial output transmitted data signal.
VALVE	Signal to turn valve on and off.
VBATT	Signal used to monitor battery voltage.
+VBATT, -VBATT	Positive and negative battery wires.
VCO2	CO2 bench output voltage, indicates CO2 concentration.
VLED	Unregulated power from external Charger.
+VP	Unregulated power either from battery of from external Charger.
V-RAM	+5 VDC voltage when unit is on, or +3VDC voltage if unit is off. Used to continuously power RAM and Real Time Clock.
VREF, 2.500V	2.500 VDC reference voltage.

SIGNAL	DESCRIPTION
VCC	VCC is the regulated +5 VDC supply generated by +5 volt power supply regulator chip U20 and its discrete components.
VDD	Same as VCC.
VSS	Digital ground.
WDI	Watch dog timer input signal, resets watch dog timer.
/XCS, /XRD, /XWR, XA0	Signals generated by U4 to control display board.

Chapter 4: Oximeter Board (LOX) Circuit Description.

General Description.

LOX Board is an optional board used in the Capnocheck® Plus Monitor when the Oximetry option is selected by the customer. It takes power from the internal isolated Power Supply and communicates with the master microprocessor on the Main board through an optically isolated interface.

Power Supply

The isolation transformer which powers the LOX board is located on the Main Board. Unregulated +8VDC and -8VDC come to the LOX board through the three pin connector J2. Two voltage regulators: positive U3 and negative U4 convert voltages down to +5VDC and -5VDC.

Isolated Interface and Reset Circuitry.

Bi-directional communications between LOX board and the Main board are provided through an optically isolated interface built around U1 and U2. Transistor Q1 is used to drive U1's internal LED.

The master microprocessor can reset the LOX microprocessor in case of lost communication caused by an ESD discharge. To do so, it transmits a continuous sequence of "zeroes", which cause the open collector output of U1 to stay pulled down for most of the time. Capacitor C54 slowly charges through R5, and transistor Q6 saturates, thereby, resetting the LOX microprocessor. At power up C21 provides a "normal" reset.

Microprocessor Circuit and Analog-to-Digital Converter.

The LOX board uses a single chip microcontroller, U5 87C51. It controls the analog front-end Analog-to-Digital Converter (ADC), U6, and communications to the master microprocessor. The clock frequency necessary for the ADC is also generated inside U5 and is equal to 2.4576MHZ. Data to and from the ADC is transferred in synchronous serial mode. ADC U6 contains an internal voltage reference (output 4), which is used throughout all circuitry.

LED Drive

LED Drive circuitry is used to turn on and off the Oximetry probe LED's, precisely controlling the current through them. The second half of the variable potentiometer U11 (sheet 3) is used to generate voltage between 0 and 2.5VDC. U11 is controlled, serially, by the microcontroller. Operational amplifier U10B together with transistor Q3 create a constant current sink. The current is proportional to the voltage generated by variable potentiometer. The H-bridge Q4-Q5 (sheet 4) is used to activate either LED, red or infrared, inside the Oximeter probe. The following table describes the states of the H-bridge:

RED-DRV	IR-DRV	/RED-ENBL	/IR-ENBL	Function
1	0	0	1	Red LED is on
0	1	1	0	Infrared LED is on
0	0	1	1	"Open circuit" state

In this table 1 indicates logic 1, 0 indicates logic 0.

The "Open circuit" state is used to check for a possible probe cable fault. In case of probe cable fault, one of the LED wires can short to the ground shield causing high current through the probe LED. To prevent this, before turning any LED on, the microcontroller checks the cable by "floating" the H-bridge. If the cable is shorted, CON3 and CON2 connections are pulled low, and comparator U13B generates /PRB_FAULT signal, which causes the microcontroller to shut down the LED excitation cycle and generate appropriate message.

Analog Signal Processing

The differential transconductance amplifier (sheet 4), formed by U12 and U9B, converts the photodetector's current output to a voltage at TP9 (V-AMB). Amplifier U8B offsets the signal at TP9 so the signal baseline is at 3.4 VDC, allowing a wider signal range for the negative-going pulses at TP9.

Comparator U13A is used to inform the microprocessor if U9B is saturated by an excess of ambient light.

V-AMB is passed through blocking capacitor C19 (sheet 3) to remove the signal's DC component. The signal is then buffered and amplified by U9A. Gain is defined by the first channel of digital potentiometer U11. The output of U9A is routed to the integrator-filter-offset circuitry U8A, controlled by

analog switch U7. The output of the integrator is passed through offset stage U10A and then routed to the ADC for measurement.

Signal Dictionary

This section lists, in alphabetical order, the signal names used on the schematics. The signal's origin, destination, and purpose are described.

Oximeter Board

SIGNAL	DESCRIPTION
/AMB-FAULT	Signal informing microcontroller about excess of ambient light.
AMB	Signal adding offset to the integrator U8A.
ANA+5	The +5 volt power supply VCC is filtered to produce ANA+5. ANA+5 powers the analog circuitry.
ANA-5	The -5 volt power supply is filtered to produce ANA-5. ANA-5 powers the analog circuitry.
CAP-GND	Signal used to short blocking capacitor C22 to ground.
CKS	CKS is the high-speed, synchronous serial output clock signal.
CON2, CON3	Probe LED's driving signals
INTGRAT, RST-INT	Signals used to control integrator U8A.
IR-DRV, RED-DRV, /IR-ENBL, /RED-ENBL	Signals used to control MOSFET H-bridge Q4 and Q5, which powers probe LED's.
LED-DRV	Signal which defines LED drive current.
POT-LD	POT-LD is used to select digital potentiometer chip U11.
PRB-DET	PRB-DET is used to inform microcontroller if probe is plugged in.
/PRB-FAULT	Signal used to inform microcontroller about probe cable problem.
SIGNAL	SIGNAL originates at TP6 and is routed to ADC U6 input.
TXS	TXS is the high-speed, synchronous serial output transmitted data signal.
TXA1, RXA1	Asynchronous serial communication signals on the Master side.
V-AMB	V-AMB is the output of the front-end differential amplifier.
V-R	2.500 VDC reference voltage.
VREF	3.4 VDC reference voltage.
VCC	VCC is the regulated +5 VDC supply generated by +5 volt power supply regulator chip U3 and its discrete components.
VSS	Digital ground.

Chapter 5: System Testing

Test Equipment and Tools Required

A. Flow meter.

B. Voltmeter

Visual Inspection

A. Check that all hardware is secure.

B. Check that all pneumatic connectors are secure.

C. Check that all electrical connectors are properly oriented and securely connected.

D. Check cosmetic appearance and mechanical fit.

E. Check that all labels are properly placed and undamaged.

Power Supplies

Main Board

Battery Charger and Power Supply Test

A. Verify charger operation with no battery plugged in by checking the following test point:

1. With the (-) of the DMM to TP1, verify:

   TP2 10.0 ± 0.5 V

B. Verify the power supply operation with battery plugged in by checking the following test point:

1. With the (-) of the DMM connected to TP1, verify:

   TP2 5.0 to 7.2 V (+VBATT), depends on the state of the battery charge

   TP5 250 ± 50 mV (-VBATT), unless in trickle charge mode

   TP8 5.0 ± 0.1 VDC (VRAM)

   TP7 5.00 ± 0.05 V (+5VPWR)

2. With the (-) of the DMM connected to TP5, verify:

   TP3 1100 ± 100 mV, depending on temperature (values assume room temperature)

   TP4 535 ± 50 mV

   TP6 315 ± 100 mV, depending on temperature (values assume room temperature)

3. With the (-) of the DMM connected to J11 pin 2, verify:

   J11 pin 1 7.7 ± 0.2 V

   J11 pin 3 -7.7 ± 0.2 V

LOX Board

Power Supply and Reference

A. Verify power supply operation by checking the following voltages:

1. With the (-) of the DMM connected to TP1, verify:

   TP2 5.0 ± 0.25 V

   TP3 -5.0 ± 0.25 V

   TP10 3.40 V (3.10 to 3.71 V)

Pneumatics

Inlet Sample Flow

A. Connect the flowmeter to the moisture trap inlet with the 8 feet sample line.

B. Verify a flow rate of 150 (+20/-10) ml/min.

Occlusion Verification

A. Occlude sample inlet.

B. Verify that while in occlusion in about 30 seconds.

C. Verify that while in occlusion pump turns on to check if units is still occluded every 5 seconds until the occlusion is removed.

Appendix

Parts Lists

Assembly Drawings and Schematics

LINE	LEV	LINE/REF	PART NO/DESC	REV	QUANTITY	UM	MAC
0	0		58500A1 F/ASM TRANSPORT CO2 MONITOR	4	1.000	EA	M
1	_1	1	58519B1 CHARGER AC TRANSP CO2/NIBP	2	1.000	EA	B P
2	_1	2	58520B1 DISPLAY MODULE TRANSPORT CO2	0	1.000	EA	B P
3	_1	3	70531B1 FOOT ADHSV BACK .14 X .5 DIA	0	4.000	EA	B P
4	_1	4	58502B1 PWB ASM MAIN BOARD TRANSPORT CO2 A/T	3	1.000	EA	B P
5	_1	5	20509B1 RUBBER FOAM W/ADHESIVE	0	.250	EA	B P
6	_1	6	58505C1 BEZEL W/WINDOW/SCREEN TRANSPORT CO2	1	1.000	EA	M P
7	_1	7	58506B1 CASE TOP HALF TRANSPORT CO2	0	1.000	EA	B P
8	_1	8	58507B1 CASE BOTTOM HALF TRANSPORT CO2	0	1.000	EA	B P
9	_1	9	58516C1 CASE BACK PANEL W/SCREENING TRANS CO2	0	1.000	EA	M P
10	_1	10	58514B1 FILTER HOLDER MOLDED TRANSPORT CO2	0	2.000	EA	B P
11	_1	11	58509B1 KEYPAD SET LEFT/RIGHT TRANSPORT CO2	7	1.000	EA	B P
12	_1	12	58511B1 BRACKET DISPLAY TRANSPORT CO2	2	2.000	EA	B P
13	_1	14	71221B1 PIN CASE HANDLE NEWOX4	0	2.000	EA	B P
14	_1	15	70782A7 SPEAKER ASM CO2 TRANS/NIBP	1	1.000	EA	M P
15	_1	17	72083B1 INSULATOR FORMEX TRANSPORT CO2	0	1.000	EA	B P
16	_1	18	53130B1 CABLE ASSEMBLY RIBBON SOCKET/SOCKET	3	1.000	EA	B P
17	_1	19	20002B5 FILTER MOISTURE TRAP TRANSPORT 10/PKG	2	.100	EA	B P
18	_1	20	20632B2 FILTER CO2 ABSORBER TRANSPORT 2/PKG	1	.500	EA	B P

LINE	LEV	LINE/REF	PART NO/DESC	REV	QUANTITY	UM	MAC
19	_1	21	58525A1 PUMP ASSEMBLY TRANSPORT CO2	2	1.000	EA	M P
20	_1	22	71070B3 BENCH TRANSPORT CO2	1	1.000	EA	B P
21	_1	23	58522B1 BATTERY PACK TRANSPORT CO2	0	1.000	EA	B P
22	_1	24	58524A1 FAN ASSEMBLY TRANSPORT CO2	1	1.000	EA	M P
23	_1	25	31009B1 SPACER VIBRATION TRANSPORT CO2 NIBP	0	4.000	EA	B P
24	_1	26	71220B1 CASE HANDLE NEWOX4/NIBP/TRANSCO2	1	1.000	EA	B P
25	_1	27	31010B1 PALNUT SELF CUTTING	1	3.000	EA	B P
26	_1	28	12029B1 SPACER 3/16 X 5/32 UNTHREADED ALUMINUM	0	2.000	EA	B P
27	_1	29	12005B2 SCREW 4-40 X 1/2 PHMS PHILLIPS	0	5.000	EA	B P
28	_1	30	12026B3 SCREW TAPPING 4 X 1/4 TYPE B PHILLIPS PAN HD	0	2.000	EA	B P
29	_1	31	12003B7 SCREW 4-40 X 1/4 FHMS PHILLIPS	0	1.000	EA	B P
30	_1	32	12005B24 SCREW 4-40 X 1/8 PHMS PHILLIPS	0	4.000	EA	B P
31	_1	33	12008B2 NUT HEX 4-40	0	4.000	EA	B P
32	_1	34	12015B1 WASHER LOCK #4 EXT	0	14.000	EA	B P
33	_1	35	12005B8 SCREW 6-32 X 1/4 PHMS PHILLIPS	0	4.000	EA	B P
34	_1	36	30182B1 ADHESIVE THREADLOCK LOCTITE 242	0	.000	BT	B P
35	_1	37	71237B1 SHIM BATTERY FOAM RUBBER NEWOX4	0	1.000	EA	B P
36	_1	38	70875B1 LINE SAMPLE ASM NAFION 1'	1	1.000	EA	B P

LINE	LEV	LINE/REF	PART NO/DESC	REV	QUANTITY	UM	MAC
37	_1	39	20635B3 TUBING ASSEMBLY TRANSPORT CO2	4	1.000	EA	B P
38	_1	40	54068B TIES CABLE MINIATURE	0	1.000	EA	B P
39	_1	41	58526B1 CABLE ASM DISPLAY POWER TRANSPORT CO2	1	1.000	EA	B P
40	_1	42	71012B14 LABEL INFORMATIVE NEWOX4/TRANS CO2	0	1.000	EA	B P
41	_1	47	20495B1 LABEL Q-LINE SMALL	0	1.000	EA	B P
42	_1	51	31012B3 POST MINI SUPPORT TRANSPORT CO2	2	3.000	EA	B P
43	_1	52	58523B1 BOOT FAN CORNER TRANSPORT CO2	0	4.000	EA	B P
44	_1	53	58531B1 BRACKET BATTERY TRANSPORT CO2	2	1.000	EA	B P
45	_1	54	20038B1 CONN LUER FEMALE TAPER .09	1	2.000	EA	B P
46	_1	55	20264B1 NUT 1/4-28	0	2.000	EA	B P
47	_1	56	31083B1 ADHESIVE POLYURETHANE DUAL-PAK	0	.000	TB	B P
48	_1	57	12009B3 NUT KEPS 6-32	0	1.000	EA	B P
49	_1	58	12003B5 SCREW 6-32 X 3/8 FHMS PHILLIPS	0	1.000	EA	B P
50	_1	59	57959B1 TAPE KAPTON INSULATING 1/2"	1	.042	RL	B P
51	_1	60	12005B6 SCREW 4-40 X 5/16 PHMS PHILLIPS	0	1.000	EA	B P
52	_1	61	70868B14 INSULATOR TRANSPORT CO2	0	1.000	EA	B P
53	_1	62	20542C78 LABEL US PATENT 5,386,833	7	1.000	EA	M P
54	_1	63	68061B1 TUBING TYGON B-44-3 .125 OD X .062 ID	0	.146	FT	B P

LINE	LEV	LINE/REF	PART NO/DESC	REV	QUANTITY	UM	MAC
55	_1	64	68108B4 SAMPLE LINE 8' PE-PVC	0	.344	EA	B P
56	_1	65	56239B1 TAPE DOUBLE-SIDED FOAM 1/2"W X 1/32"T	0	.333	FT	B P
57	_1	66	58473B1 PLATE CLOSING DB9 TRANSPORT CO2	1	1.000	EA	B P
58	_1	67	20542C110 LABEL MODIFIED U.S. PAT. NO.		1.000	EA	M P
59	_1	68	31062B4 LABEL CSA TUV CHARGER 1614 1615	0	1.000	EA	B P

QTY	DESIGNATION(S)	DESCRIPTION	MANUFACTURER/PART NO.
1	BT1	Lithium Battery 3V, BR2330	Panasonic BR2330-1VC or similar
2	C1,C2	10pF NPO 50V 5% 1206 SMT	Any
53	C3,C4,C5,C6,C7,C8,C9,C10, C11,C13,C14,C15,C16,C17, C18,C20,C23, C25,C26, C30, C31,C32,C33,C34,C35, C36, C38,C41,C44,C46,C50, C52, C56,C57,C62,C64,C66, C69, C70,C73,C75,C82,C83, C84, C86,C88,C89.C90,C91, C92, C93,C40,C65	.1uF 50V 10% X7R 1206 SMT	Any
4	C12,C45,C54,C59	1uF 16V 10% TANT 3216 SMT	T491A105K016AS KEMET or Any
4	C22,C37,C60,C61	.01uF 50V 10% X7R 1206 SMT	Any
5	C19,C43,C47,C48,C51	220pF NPO 50V 5% 1206 SMT	Any
5	C21,C27,C28,C29,C49	68pF NPO 50V 5% 1206 SMT	Any
2	C55,C39	10uF 16V 10% TANT 6032 SMT	T491C106K016AS KEMET or Any
3	C42,C68,C76	1uF,50V,POLY	Panasonic ECQ-V1H105JL or similar
1	C53	6800uF,35V	Panasonic ECO-S1VP682CA or similar
1	C58	180uF,35V,LOW ESR	Panasonic ECA-1VFQ181
6	C63,C67,C74,C77,C80,C81	56uF,16V,LOW ESR	Panasonic ECA-1CFQ560
2	C71,C78,C87	330uF,6.3V	Panasonic ECA-0JFQ331
1	C72	1200uF,6.3V	Panasonic ECA-0JFQ122L
2	C85,C79	22pF NPO 50V 5% 1206 SMT	Any
1	C94	5.6pF NPO 50V ±0.5±F 1206 SMT	Any
7	D1,D5,D6,D7,D9,D10,D11	BAV99LT1 SOT-23	Any
1	D2	SMBG48A	TAITRON or TGL41-47A or TGL41-43A
2	D3,D4	MBR745	TAITRON or MOTOROLA or MBR1035 INTERNATIONAL RECTIFIER,
9	FB1,FB2,FB3,FB4,FB5,FB6, FB7,FB16,FB17	KCB-1206 1206 SMT	Associated Components
8	FB8,FB9,FB10,FB11,FB12, FB13,FB14,FB15	CAPACITOR FEED 470pF	MURATA NFM40R11C471 or NFM40R11C102
6	FB18,FB19,FB20,FB21,FB22, FB23	BLM21A601S	MURATA BLM21A601S
1	JP1	2 POS SIL HEADER .1"	MOLEX 22-03-2021 or similar
1	J1	CON5 SIL .1"	3M 926781-01-05-I
1	J2	CON26 DIL HEADER	88880-074 or 88880-051 Berg Electronics or 3M 2526-6002UG
2	J3,J4	6 POS CONNECTOR	TRIO MATE 520315-6 AMP
3	J5,J6,J13	2 POS SIL LOCK. HEADER .1"	640456-2 AMP or similar (20412B1)
1	J7	DB25 FEMALE RIGHT ANG.	747238-3 AMP or similar
1	J8	RJ-11	MOLEX 95009-2661or SPC Teck. TA-250-6 (70949B1)

ORIGINAL

QTY	DESIGNATION(S)	DESCRIPTION	MANUFACTURER/PART NO.
1	J9	POWERJACK	DJ005B LZR
1	J10	CON3 LOCK. .156"	26-48-1035 MOLEX or similar
1	J11	CON3 SIL .1"	3M 926781-01-03-I
1	J12	CON2 LOCK. .156"	26-48-1025 MOLEX or similar
1	L1	68uH,3.5A	HURRICANE LABS HL-EI168M/AB
1	L2	10uH,2A	HURRICANE LABS HL-EI110P/AB
1	MP1	MPX5100AP	PRESSURE SENSOR OR MOTOROLA
6	Q1,Q2,Q3,Q8,Q9,Q10	MMBTA3906LT1	SOT-23, Any
1	Q4	SI9955DY	SILICONIX, or SI9956DY SILICONIX, or IRF7101 or IRF7103 or IRF7105 Intern'l Rectifier, or DID2009 or DID2003 Diodes Inc.
1	Q5	MMBTA55LT1	SOT-23, Any
3	Q6,Q7,Q13	MMBTA05LT1	SOT-23, Any
1	Q11	IRFZ40	TO-220, INTERNATIONAL RECTIFIER
1	Q12	2N7002	SOT-23, Any
1	Q14	SI9942DY	SILICONIX, or SI9952DY SILICONIX, or DID2002 Diodes Inc
8	R1,R12,R13,R14,R15,R16, R39,R58,R82	2.49K, 1%	1206 SMT
5	R2,R3,R38,R74	806K, 1%	1206 SMT
2	R83,R84	82, 5%	1206 SMT
7	R5,R6,R18,R20,R22,R44, R47	270, 5%	1206 SMT
14	R7,R8,R9,R10,R11,R32,R40, R41, R43,R66,R67,R70,R71,R76	100K, 1%	1206 SMT
7	R17,R19,R21,R29, R37,R55,R68	11K, 1%	1206 SMT
9	R25,R26,R42,R50,R59,R60, R78,R79,R87	53.6K, 1%	1206 SMT
6	R27,R28,R30,R61,R69	19.6K, 1%	1206 SMT
1	R31	150K, 1%	1206 SMT
6	R33,R34,R35,R56,R77,R80	1.8K, 5%	1206 SMT
1	R45	49.9,.1%,.5W	PRP GP1/2TC50 49.9Ohm .1%,
6	R46,R49,R51,R52,R53,R54	51, 5%	1206 SMT
1	R48	R-PACK CO2	SO-8, OHMTEK, BCI P/N 10019B1, OHMTEK P/N 106-437
1	R57	470, 5%	1206 SMT
1	R63	.18 ohm or .2 ohm, 5%, 1W	K-TRONICS MWW1 .18 OHM 5% or MWW1 .2 OHM 5%
1	R64	590K,0.1%	PRP GP1/4 TC50 590K .1%
1	R65	200K,0.1%	PRP GP1/4 TC50 200K .1%
4	R36,R72,R73,R81	5.1K, 5%	1206 SMT
1	R75	240K, 5%	1206 SMT
3	R85,R86,R88	200, 1%	0805 SMT

ORIGINAL

QTY	DESIGNATION(S)	DESCRIPTION	MANUFACTURER/PART NO.
17	TP1,TP2,TP3,TP4,TP5,TP6, TP7,TP8,TP9,TP10,TP11, TP12,TP13,TP14,TP15,TP16, TP17	Test Point	TP-103-03 COMPONENTS CORP. or similar
1	T1	Common Mode Choke	PLT09H-2003R MURATA
2	T3,T4	10K @ 25C,-4.41%/C	KC003T Keystone
1	T5	TR ISO 3	BCI P/N 58513B1 Rev. C, INGLOT P-5892
1	U1	Z8S18020VSC	Zilog
1	U2	27C010 PLCC	AT27C010L-15JC or AT27C010-15JC ATMEL or NM27C010V150 NATIONAL SEM.
1	(U2)	SOCKET 821977-1	AMP
1	U3	HM628128LFP-8	Hitachi or similar
1	U4	EPM7032TC44-15(or faster)	Altera
2	U5,U6	74HC245	SMT, Any
2	U7,U8	74HC259	SMT, Any
1	U9	MAX512CSD	Maxim
1	U10	LT1181ACS	Linear Technology or MAX202ECWE Maxim
1	U11	DS1202S8	Dallas Semiconductor
1	U12	LM324M	SO-14, National Semi. or any
1	U13	AD822AR	Analog Devices
1	U14	AD7858LAR	Analog Devices
1	U15	OP284FS	Analog Devices
1	U16	AD780AR	Analog Devices
1	U17	MAX713CSE	MAXIM
1	U18	LT1074CT	Linear Technology
1	U19	MAX690ACSA	MAXIM
1	U20	MIC5157BM	Micrel
1	U21	74HC132	SMT, Any
1	U100	20 PIN 0.4" SOCKET	Mill-Max P110-13-420-41-001000
1	V1	VALVE 3-WAY	LFAA0503418H LEE CO.
1	X1	18.432MHZ	EPSON CA-301 18.432M-C
1	X2	32768Hz	M-TRON MMCC-1-32.768 KHZ, BCI 70327B1
1	400	PWB FAB	BCI P/N 58501B1
6	401	#4-40 X 1/4 SCREW	BCI P/N 12005B1
2	402	6/32 X 5/8 NYLON SCREW	Any
2	403	6/32 NYLON NUT	BCI P/N 20161B2
3	404	#4 WASHER LOCK EXT.	BCI P/N 12015B1
3	405	SHOLDER WASHER	BCI P/N 20308B1
4	406	SIL-PAD	BCI P/N 56228B4
1	408	HEAT SINK	BCI P/N 58515B1
2	409	J7 HARDWARE	BCI P/N 20522B2
1	500	EMI SHIELD	BCI P/N 58532B1
1	501	SOFTWARE ASM.	BCI P/N 58512A1
2	502	#4-40 X 5/16 SCREW	BCI P/N 12005B6
2	503	#4-40 NUT HEX (SMALL PAT)	BCI P/N 49041B2

ORIGINAL

QTY	DESIGNATION(S)	DESCRIPTION	MANUFACTURER/PART NO.
2	504	#4 SPLIT RING WASHER	BCI P/N 12019B3
A/R	505	HOT GLUE, FULLER HM-2124	BCI P/N 58326B1
A/R	506	RTV 162, SILICONE	BCI P/N 57293B1
.167	507	TAPE KAPTON INSULATING	BCI P/N 57959B1
4	508	#6 WASHER, FLAT .031 THK.	BCI P/N 53055B2

NOTES:

1) U4 MUST BE PROGRAMMED BEFORE INSTALLATION, CONTACT BCI FOR INSTRUCTIONS
2) R48 IS A CUSTOM RESISTOR NETWORK MANUFACTURED BY OHMTEK. CONTACT BCI FOR INSTRUCTIONS.
3) BATTERY BT1 IS INSTALLED MANUALLY AFTER ALL COMPONENTS ARE INSTALLED.

ORIGINAL

DESCRIPTION	QTY	DESIGNATION(S)	MANUFACTURER'S PART NO.
.1uF,50V,20%	27	C1,C3,C6,C7,C9,C11, C13,C14,C15,C17,C19, C23,C24,C26,C27,C30, C31,C32,C33,C35,C41, C43,C49,C50,C51,C52, C54	0805 Z5U SMT,Any
33pF,6000V	1	C2	SPRAGUE 60GAQ33
10pF,50V,5%	4	C4,C5,C29,C53	0805 NPO SMT,Any
.01uF,50V,10%	2	C8,C10	0805 X7R SMT,Any
10uF,TANT,16V	5	C12,C18,C20,C34,C36	6032 TANT SMT,Any
100uF,6.3V	1	C16	107RSS6R3M ILLINOIS CAP.
1uF,TANT,16V	2	C21,C42	3216 SMT,Any
.1uF,POLY	1	C22	ECQ-V1H104JZ3 PANASONIC
6800pF,2%	1	C25	ECQ- P1H682GZ PANASONIC OR WIMA FKP2 6800pF 63V
1nF,NPO	1	C28	0805 NPO SMT, ECU-V1H102JCX PANASONIC OR Any
68pF,50V,5%	2	C37,C38	0805 NPO SMT,Any
220pF,50V,5%	2	C39,C40	0805 NPO SMT,Any
470uF,10V,LOW ESR	1	C48	ECA-1AFQ471 PANASONIC
BAV99LT1 or BAV99TR or BAV99TA	2	D1,D2	SOT-23 MOTOROLA DIODES INC. ZETEX
BLM41A01PT	1	FB1	MURATA ERIE
CON5	1	J1	MOLEX 22-17-2052
CON3	1	J2	MOLEX 22-17-2032
7 POS HEADER	1	J3	926141-01-07-I 3M
COM MODE INDUCTOR 15uH	1	L1	* BCI P/N 71138B1
MMBTA55LT1	3	Q1,Q2,Q6	SOT-23,MOTOROLA
MMBTA05LT1 or MMBTA06LT1	1	Q3	SOT-23,MOTOROLA
SSD2005	1	Q4	SAMSUNG SSD2005 OR T.I. TPS1120 OR DIODES INC. DID2005 OR INT'L RECTIFIER IRF7104
SSD2003	1	Q5	SAMSUNG SSD2003 OR INT'L RECTIFIER IRF7101,IRF7103 OR DIODES INC. DID2003, DID2009 OR SILICONIX, SI9956
11K,1%	13	R1,R2,R4,R13,R14, R29,R30,R31,R32, R36,R46,R49,R50	0805 SMT,Any
1K,5%	2	R3,R12	0805 SMT,Any
249K,1%	10	R5,R6,R7,R8,R9,R11, R22,R27,R28,R41	0805 SMT,Any
44.2K,1%	5	R15,R42,R45,R47,R48	0805 SMT,Any
24.9K,1%	5	R16,R34,R35,R37,R38	0805 SMT,Any
47,5%	3	R17,R23,R24	0805 SMT,Any

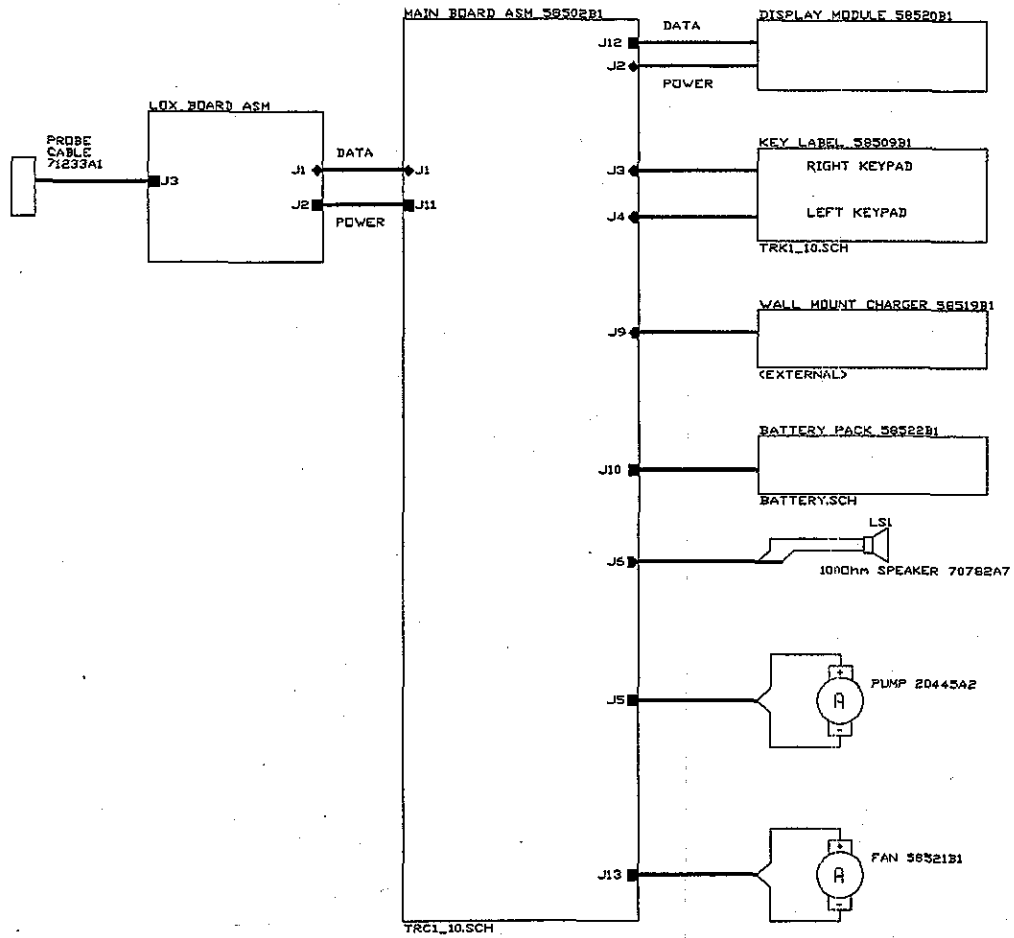
ORIGINAL

DESCRIPTION	QTY	DESIGNATION(S)	MANUFACTURER'S PART NO.
15,1%	2	R18,R19	0805 SMT,Any
270,5%	2	R20,R33	0805 SMT,Any
2.15K,1%	7	R21,R25,R26.R39,R40, R43,R44	0805 SMT,Any
TEST POINT	10	TP1,TP2,TP3,TP4,TP5, TP6,TP7,TP8,TP9,TP10	TP-103-03 COMPONENTS CORP.
PC900V	2	U1,U2	DIP-8,SHARP
MC78L05ACD	1	U3	SO-8,MOTOROLA or uA78L05ACD TI
MC79L05ACD	1	U4	SO-8,MOTOROLA or TI
87C51PLCC	1	U5	AT89C51-16J ATMEL
AD7853AR	1	U6	SOL-24 (WIDE),ANALOG DEVICES
DG308ACY	1	U7	SO-16,SILICONIX, MAXIM, or HARRIS
TLC272CD	2	U8,U12	SO-8,TI
AD822AR	1	U9	SO-8,ANALOG DEVICES
OP283GS	1	U10	SO-8,ANALOG DEVICES
DS1267S-10	1	U11	SOL-16 (WIDE),DALLAS SEM.
LM393M	1	U13	SO-8,NATIONAL SEMICONDUCTOR
14.7456MHZ	1	X1	EPSON CA-301 14.7456M-C
PWB FAB	1	400	BCI P/N 58455B1
SOFTWARE ASM	1	401(SEE NOTE 3)	* BCI P/N 58463A1
SOCKET, PLCC	1	SKT1	AMP 822275-1 or EQUIVALENT
COVER SHIELD	1	402	BCI P/N 71017B1
BARRIER INSULATING	1	403	* BCI P/N 20511B1
CAPACITOR .33uF 50V 10%	1	404	BCI P/N 13000B32

ORIGINAL

* INDICATES PARTS SUPPLIED BY BCI.

DRWG NO: 58500S1	
REV.	DESCRIPTION



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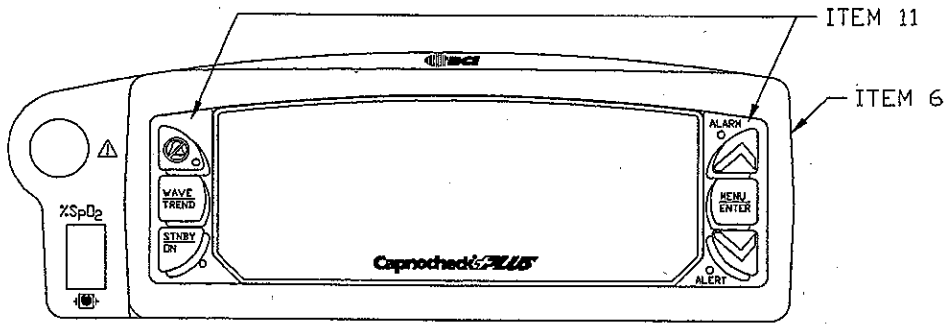
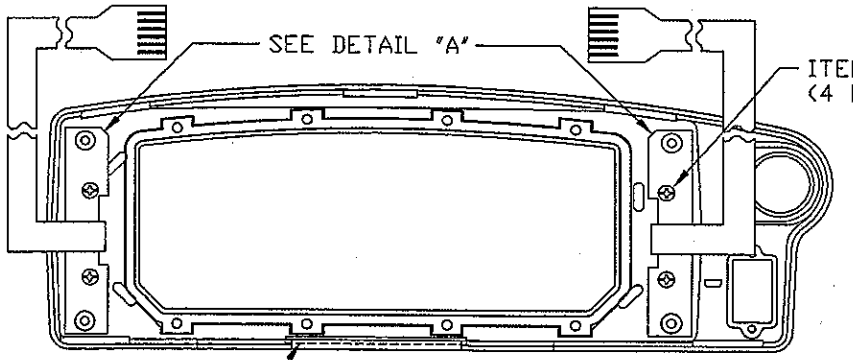
		MFG. APPR.:
		DATE:

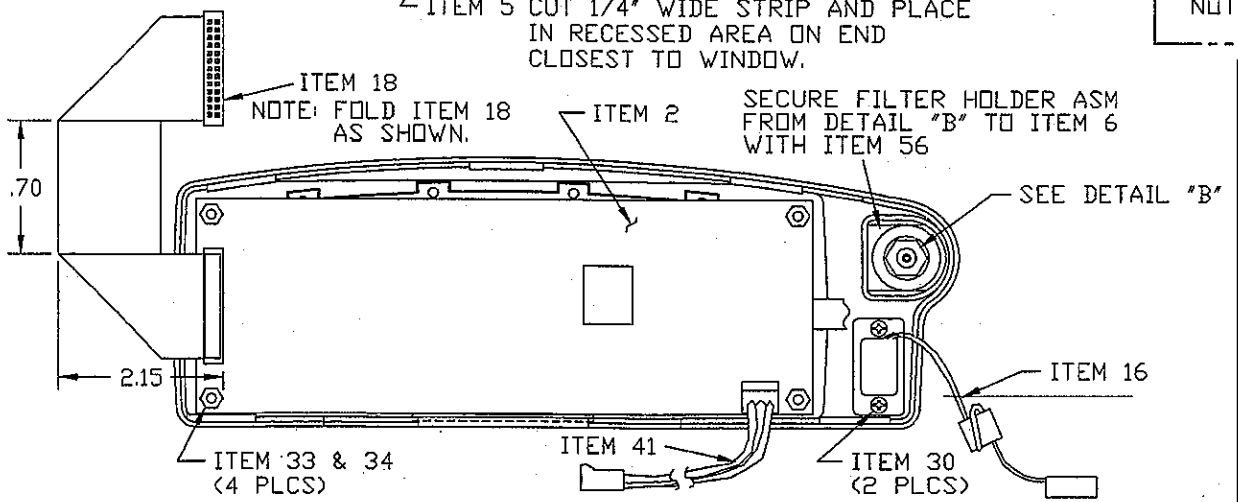
TITLE: SYSTEM SCHEMATIC CO2 TRANSPORT	DRWG NO: 58500S1	REV. 0
	SHT. 1 OF 1	

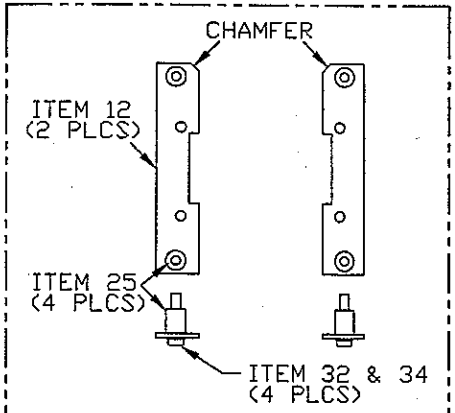
A-11





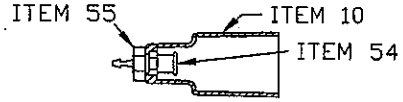
ITEM 5 CUT 1/4" WIDE STRIP AND PLACE IN RECESSED AREA ON END CLOSEST TO WINDOW.





DETAIL "A"

NOTE: ASSEMBLY TWO BRKTS, NOTE ORIENTATION OF CHAMFER.



DETAIL "B"

NOTE: ASSEMBLY TWO FILTER HOLDERS.

ORIGINAL

DRWG NO: 58500A1	
REV.	DESCRIPTION
1	SEE SHT'S 3 & 5 & 6 C/N'S 2716 & 2730 SDP/CLL 11-13-96
2	SEE SHTS 3, 4 & 5. C/N#2983 SDP 2-25-97
3	SEE SHEETS 4 & 6. C/N#4045 MER 6-19-97
4	SEE SHEET 6. C/N#3097 MER 6-30-97
5	ADDED ITEM 49, SEE SHEET 2. C/N 4235 CLL 12-3-97

BCI INTERNATIONAL

DRAWN BY: RJR	CHK. BY: DWD	ENG. APPR. E.PALATNIK
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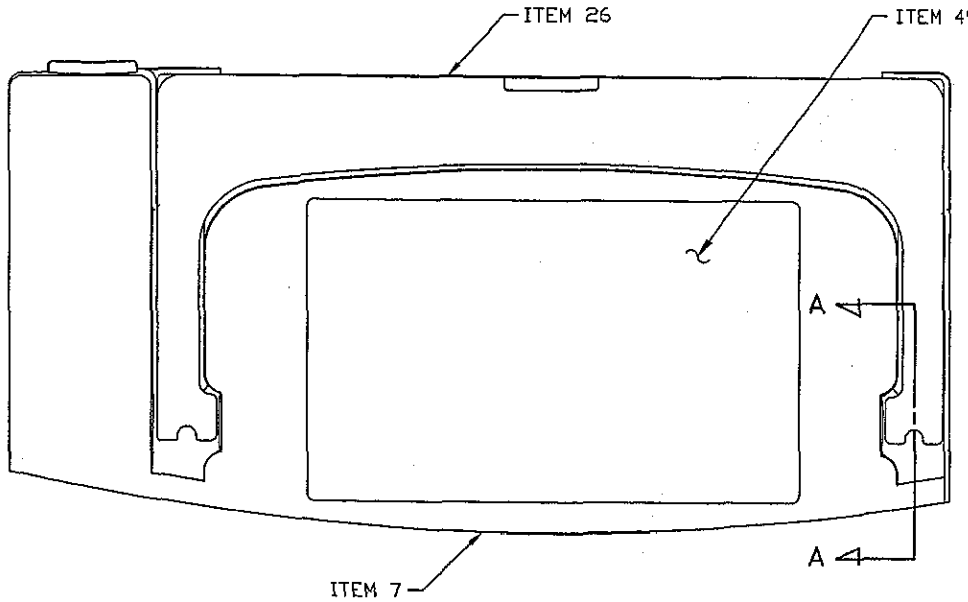
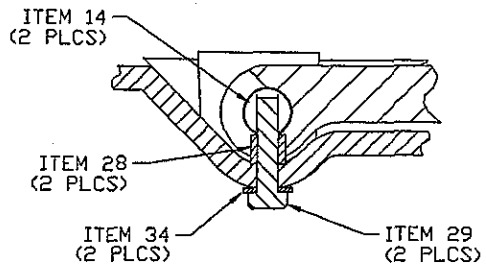
		MFG. APPR.: MS
		DATE: 8-16-96
MATERIAL:		TOLERANCE UNLESS OTHERWISE SPECIFIED: XX: ± .020 XXX: ± .005 ANGLES: ± 1°
FINISH:		
TITLE: F/ASM TRANSPORT CO2 MONITOR (BEZEL)	DRWG NO: 58500A1	REV. 5
	SHT. 1 OF 6	

A-12

DRWG NO: 58500A1	
REV.	DESCRIPTION
1	SEE SHT'S 3 & 5 & 6 C/N'S 2716 & 2730 SDP/CLL 11-13-96
2	SEE SHT'S 3, 4 & 5. C/N#2983 SDP 2-25-97
3	SEE SHEETS 4 & 6. C/N#4045 MER 6-19-97
4	SEE SHEET 6. C/N#3097 MER 6-30-97
5	ADDED ITEM 49 C/N#4235 CLL 12-3-97



ORIGINAL



SECTION A-A

BCI INTERNATIONAL

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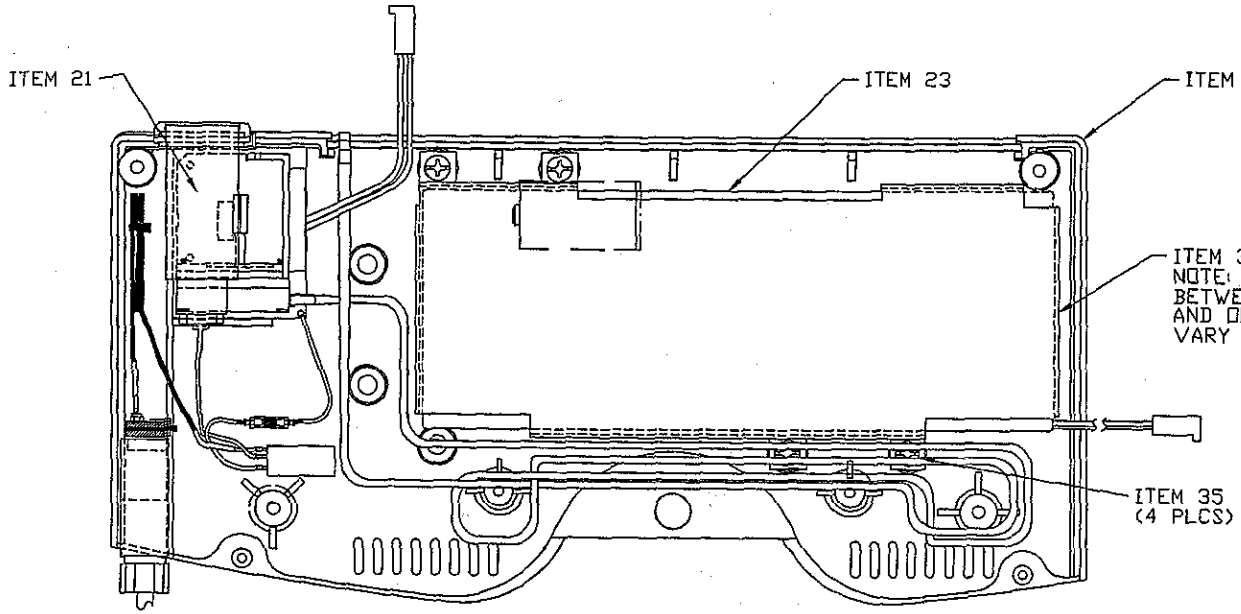
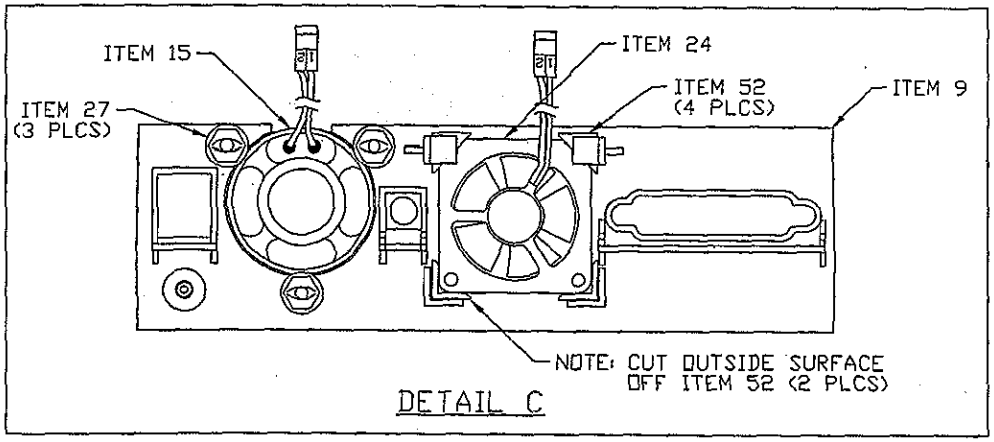
		MFG. APPR.: MS
		DATE: 8-16-96
MATERIAL:		TOLERANCE UNLESS OTHERWISE SPECIFIED: XX: ± .020 XXX: ± .005 ANGLES: ± 1°
FINISH:		
TITLE: F/ASM TRANSPORT CO2 MONITOR (TOP & HANDLE)		DRWG NO: 58500A1 REV. 5
		SHT. 2 OF 6

A-13

DRWG NO: 58500A1	
REV.	DESCRIPTION
1	REVISED ITS 37 & 53 NOTES. ROTATED SPEAKER TO POSITION WIRES ON TOP ALSO SEE SHTS 5 & 6. C/N'S 2716 & 2730 SDP/CLL 11-13-96
2	ADDED NEW PUMP & TUBING ASSEMBLY. C/N#2983 SDP2-24-97
3	SEE SHEETS 4 & 6. C/N#4045 MER 6-19-97
4	SEE SHEET 6. C/N#3097 MER 6-30-97
5	SEE SHEET 2. C/N#4235 CLL 12-3-97



ORIGINAL



DETAIL C

BCI INTERNATIONAL

DRAWN BY: RJR	CHK. BY: DWD	ENG. APPR. E.PALATNIK
DATE: 7-25-96	DATE: 8-13-96	DATE: 8-13-96
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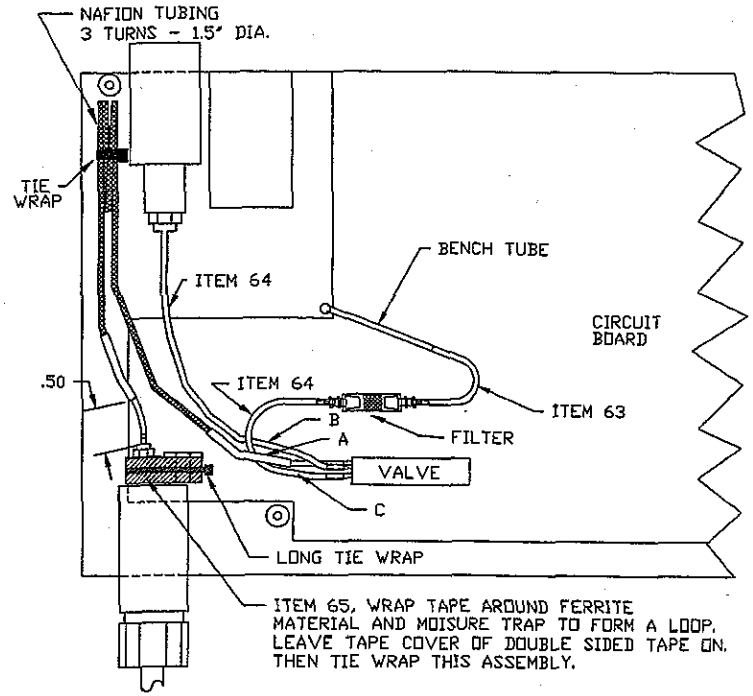
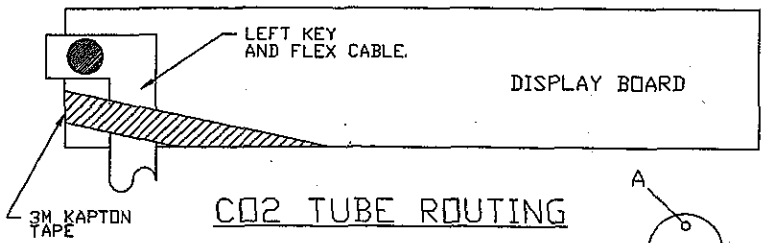
		MFG. APPR.: MS
		DATE: 8-16-96
MATERIAL:		TOLERANCE UNLESS OTHERWISE SPECIFIED: XX: ± .020 XXX: ± .005 ANGLES: ± 1°
FINISH:		
TITLE: F/ASM TRANSPORT CO2 MONITOR (BOTTOM & BACK PANEL)	DRWG NO: 58500A1	REV. 5
	SHT. 3 OF 6	

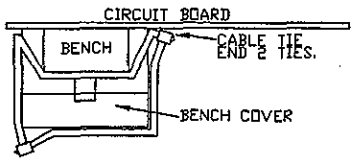
A-14

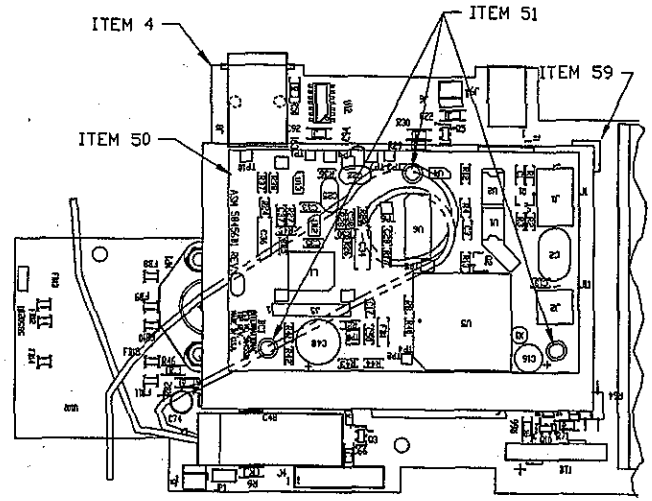




C02 TUBE ROUTING

VALVE FRONT VIEW





OXIMETER AND MAIN PWB ASM

NOTE: FOLD 2 SIDES OF ITEM 17 UP AND TAPE TOGETHER WITH ITEM 59 BEFOR INSTALLING.

ORIGINAL

DRWG NO: 58500A1	
REV.	DESCRIPTION
1	SEE SHT'S 3 & 5 & 6 C/N'S 2716 & 2730 SDP/CLL 11-13-96
2	COMPLETELY REVISED TUBE ROUTING. ADDED ITEMS 17 & 59. ALSO SEE SHEETS 3 & 5. C/N 2983 SDP 2-25-97
3	REMOVED ITEM 17. SEE SHEET 6. C/N 4045 MER 6-19-97
4	SEE SHEET 6. C/N 3097 MER 6-30-97
5	SEE SHEET 2. C/N 4235 CLL 12-3-97

BCI INTERNATIONAL

DRAWN BY: RJR	CHK. BY: DWD	ENG. APPR: E.PALATNIK
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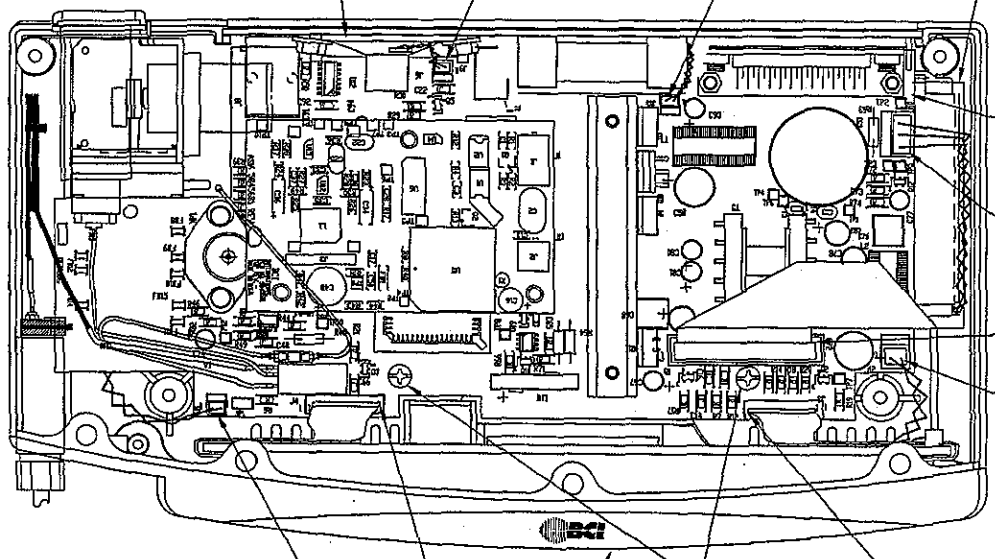
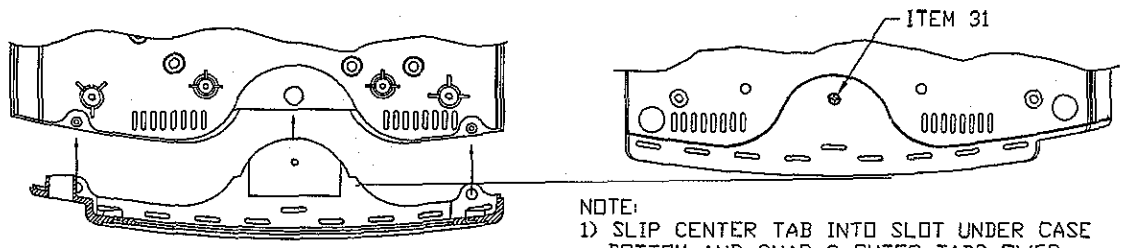
		MFG. APPR: MS
MATERIAL:		DATE: 8-16-96
FINISH:		TOLERANCE UNLESS OTHERWISE SPECIFIED: XX: ± .020 XXX: ± .005 ANGLES: ± 1°
TITLE: F/ASM TRANSPORT C02 MONITOR (TUBING & OXI/MAIN PWB ASM)	DRWG NO: 58500A1	REV. 5
	SHT. 4 OF 6	

A-15



DRWG NO: 58500A1	
REV.	DESCRIPTION
1	ADDED ITEM 61 ALSO SEE SHT'S 3 & 6 C/N'S 2716 & 2730 SDP/CLL 11-13-96
2	REDREW TO REFLECT NEW PUMP ASM. C/N#2983 SDP2-25-97
3	SEE SHEETS 4 & 6. C/N#4045 MER 6-19-97
4	SEE SHEET 6. C/N#3097 MER 6-30-97
5	SEE SHEET 2. C/N#4235 CLL 12-3-97

ORIGINAL



DETAIL D

NOTE:
1) SLIP CENTER TAB INTO SLOT UNDER CASE BOTTOM AND SNAP 2 OUTER TABS OVER SMALL PINS INSIDE CASE BOTTOM.
2) SECURE BEZEL TO CASE BOTTOM WITH ITEM 31.

BCI INTERNATIONAL

DRAWN BY: RJR	CHK. BY: DWD	ENG. APPR. E.PALATNIK
DATE: 7-25-96	DATE: 8-13-96	DATE: 8-13-96
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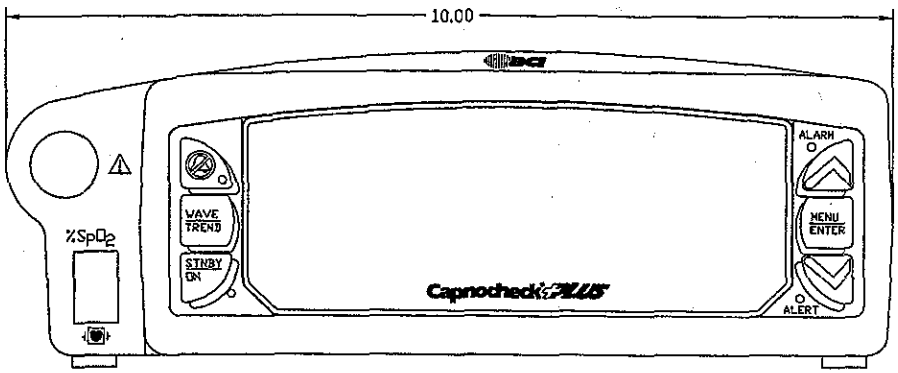
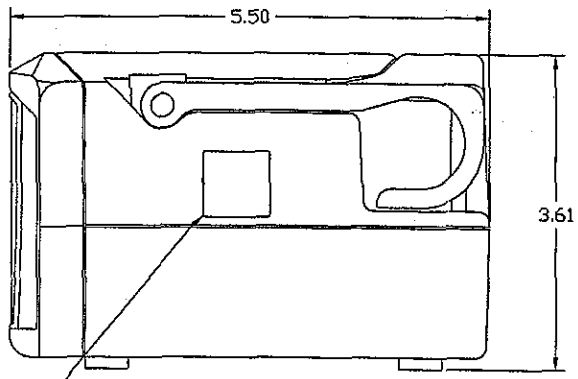
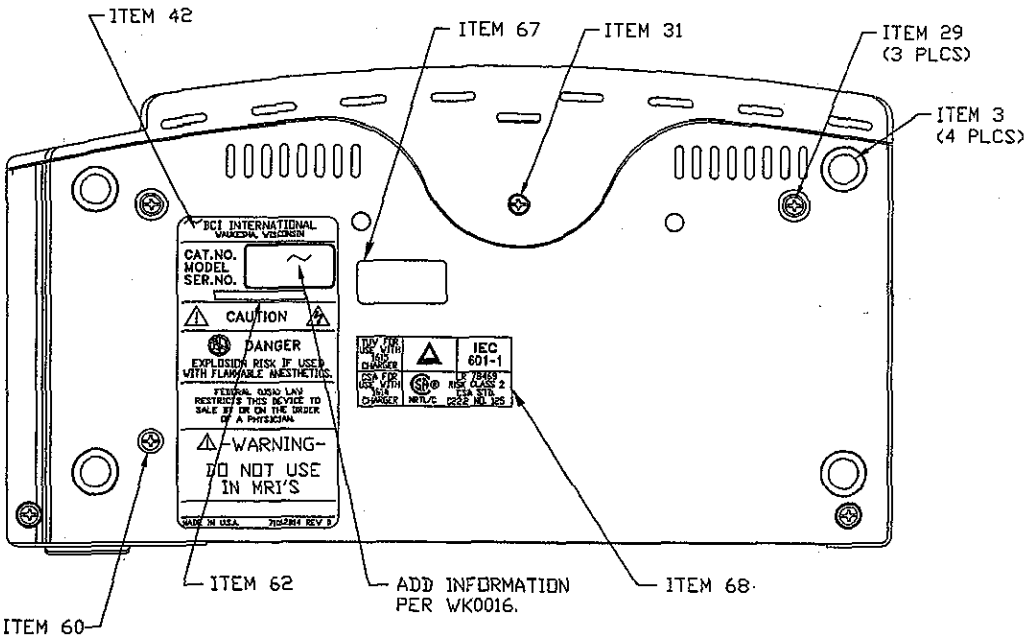
		MFG. APPR.: MS
		DATE: 8-16-96
MATERIAL:		TOLERANCE UNLESS OTHERWISE SPECIFIED: XX: ± .020 XXX: ± .005 ANGLES: ± 1°
FINISH:		
TITLE: F/ASM NEWDX4 MONITOR (BEZEL, BOTTOM & PWB)		DRWG NO: 58500A1 REV. 5
		SHT. 5 OF 6

A-16





DRWG NO: 58500A1	
REV.	DESCRIPTION
1	REMVD IT'S 43-45 &49. REVISED IT. 42. ADDED IT. 60 & 62. IT. 29 WAS 4 PLCS. C/N'S 2740 & 2730 SDP/CLL 11-13-96
2	SEE SHT'S 3, 4 & 5. C/N#2938 SDP 2-25-97
3	ADDED ITEM 67. SEE SHEET 4. C/N#4045 MER 6-19-97
4	ADDED ITEM 68. C/N#3097 MER 6-30-97
5	SEE SHEET 2 C/N 4235 CLL 12-3-97



NOTE:
1) TO ATTACH COVER, ALIGN INSERT OPENINGS WITH INSERTS IN BOTTOM HALF AND SLIDE COVER DOWN.
2) MAKE SURE THE 4 PINS ALONG THE FRONT EDGE GO INTO THE HOLES IN THE TABS ON THE TOP EDGE OF THE BEZEL TO LOCK IT IN PLACE.
3) SECURE CASE TOGETHER USING ITEM 29 AS SHOWN IN THE BOTTOM VIEW OF THE CASE.

ORIGINAL

BCI INTERNATIONAL

DRAWN BY: RJR	CHK. BY: DWD	ENG. APPR. E.PALATNIK
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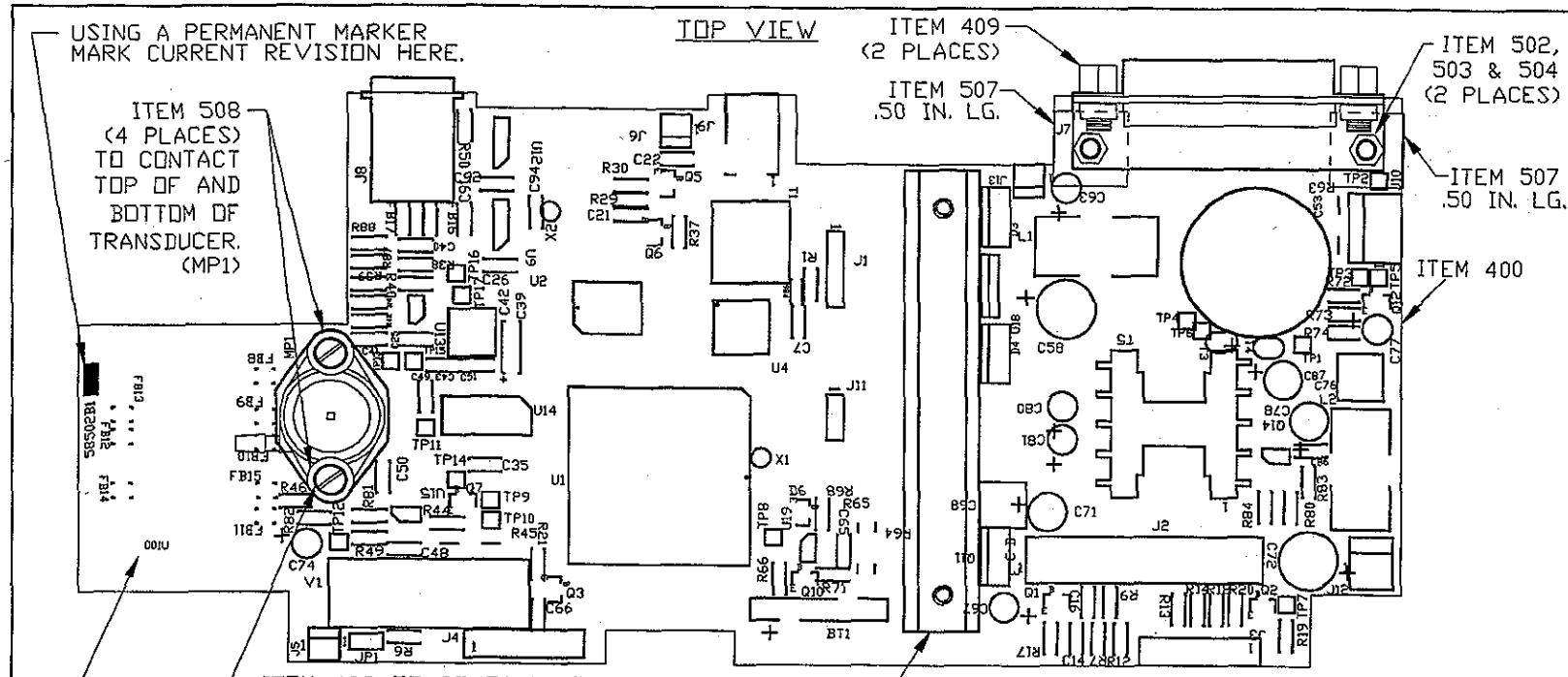
		MFG. APPR.: MS
		DATE: 8-16-96
MATERIAL:		TOLERANCE UNLESS OTHERWISE SPECIFIED: XX: ± .020 XXX: ± .005 ANGLES: ± 1°
FINISH:		
TITLE: F/ASM TRANSPORT CO2 MONITOR (CASE, FEET & LABELS)	DRWG NO: 58500A1	REV: 5
	SHT. 6 OF 6	

A-17



DRWG NO: 58502B1	
REV.	DESCRIPTION
0	PRODUCTION RELEASE, C/N# 2921 CLL 1-21-97
1	TP-17 WAS U13-3, ADDED JUMPER ON U13, & 2 RES C/N# 2983 SDP 2-25-97
2	ADDED ITEM 507, KAPTON TAPE, SEE SHEET 2 C/N# 4007 CLL 5-13-97
3	REVISED TO REFLECT REV. E BOARD LAYOUT C/N 4040 KMK 6-5-97
4	ADDED ITEM 508. REVISED ITEMS 402 & 403. SEE HISTORY FOR PREV. REVS. C/N 4293 MER 12-22-97

ORIGINAL

SHEET 3-6 "V" SIZE (BOM)

NOTE:

1) MANUFACTURER TO PLACE A "MFD BY" IDENTIFICATION MARK ON BOARD.
2) IF MANUFACTURER TESTS BOARDS, A TEST STAMP MUST BE PLACED ON THE BOARD INDICATING IT PASSED ALL TESTS.
3) VENDOR IS TO BUY, PROGRAM AND INSTALL E-PROM PER SOFTWARE ASSEMBLY ITEM 501.
4) HOT GLUE L1, L2, C58, C72, C78 C80, C81 & C87 USING ITEM 505.
5) SECURE X1 & X2 USING RTV, ITEM 506.

BCI INTERNATIONAL

DRAWN BY: RJR	CHK. BY: RJR	ENG. APPR.: E.Palatnik
DATE: 10-27-95	DATE: 1-22-97	DATE: 1-21-97
SCALE: NTS	DO NOT SCALE PRINT	Q.A. APPR.: J.M.Peter
		DATE: 1-22-97
		MFG. APPR.: M.S.
		DATE: 1-22-97

MATERIAL:

FINISH:

TOLERANCE UNLESS OTHERWISE SPECIFIED:
XX: ± .010
XXX: ± .005
ANGLES: ± 1°

TITLE: PWB ASM MAIN BOARD - C02 TRANSPORT

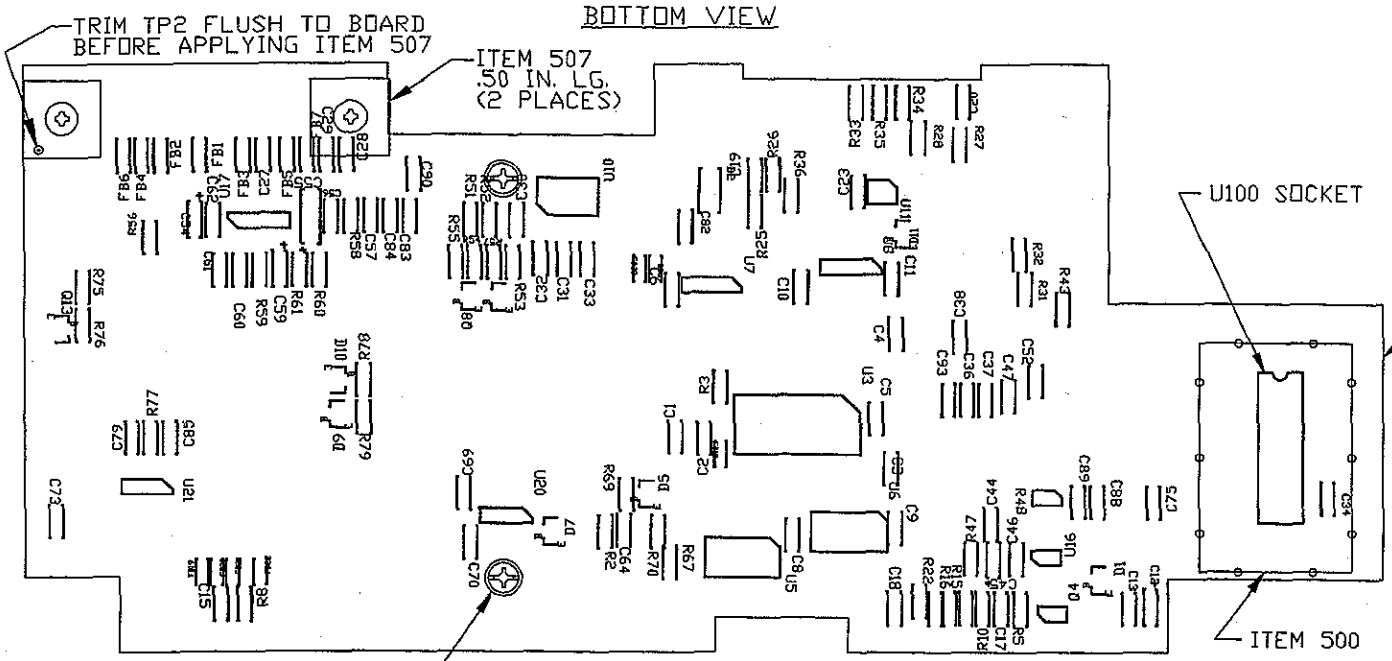
DRWG NO: 58502B1 REV. 4

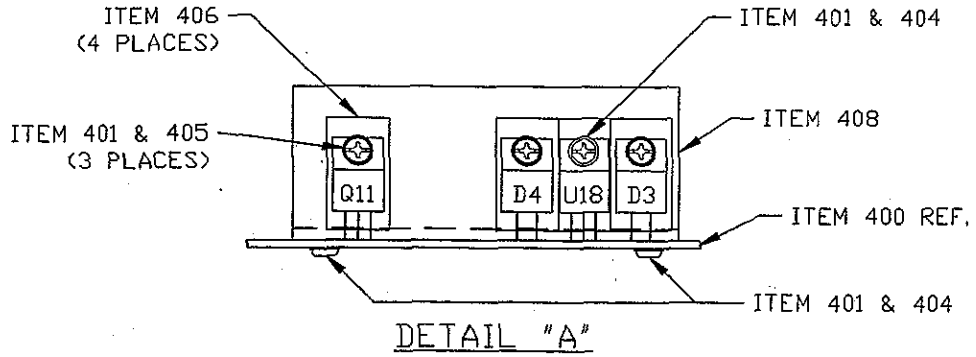
SHT. 1 OF 6

A-18

DRWG NO: 58502B1	
REV.	DESCRIPTION
0	SEE SHEET 1 C/N# 2921 CLL 1-21-97
1	REM'VD R31, 32, & C24. C/N# 2983 SDP 2-25-97
2	ADDED ITEM 507, KAPTON TAPE, SEE SHEET 1 C/N# 4007 CLL 5-13-97
3	REVISED TO REFLECT REV. E BOARD LAYOUT C/N 4040 KMK 6-5-97
4	SEE SHEET 1 C/N# 4293 MER 12-22-97

BOTTOM VIEW





DETAIL "A"

ORIGINAL

BCI INTERNATIONAL

DRAWN BY: RJR	CHK. BY: RJR	ENG. APPR.: E.Palatnik
DATE: 10-27-95	DATE: 1-22-97	DATE: 1-21-97
SCALE: NTS	DO NOT SCALE PRINT	Q.A. APPR.: J.M.Peter
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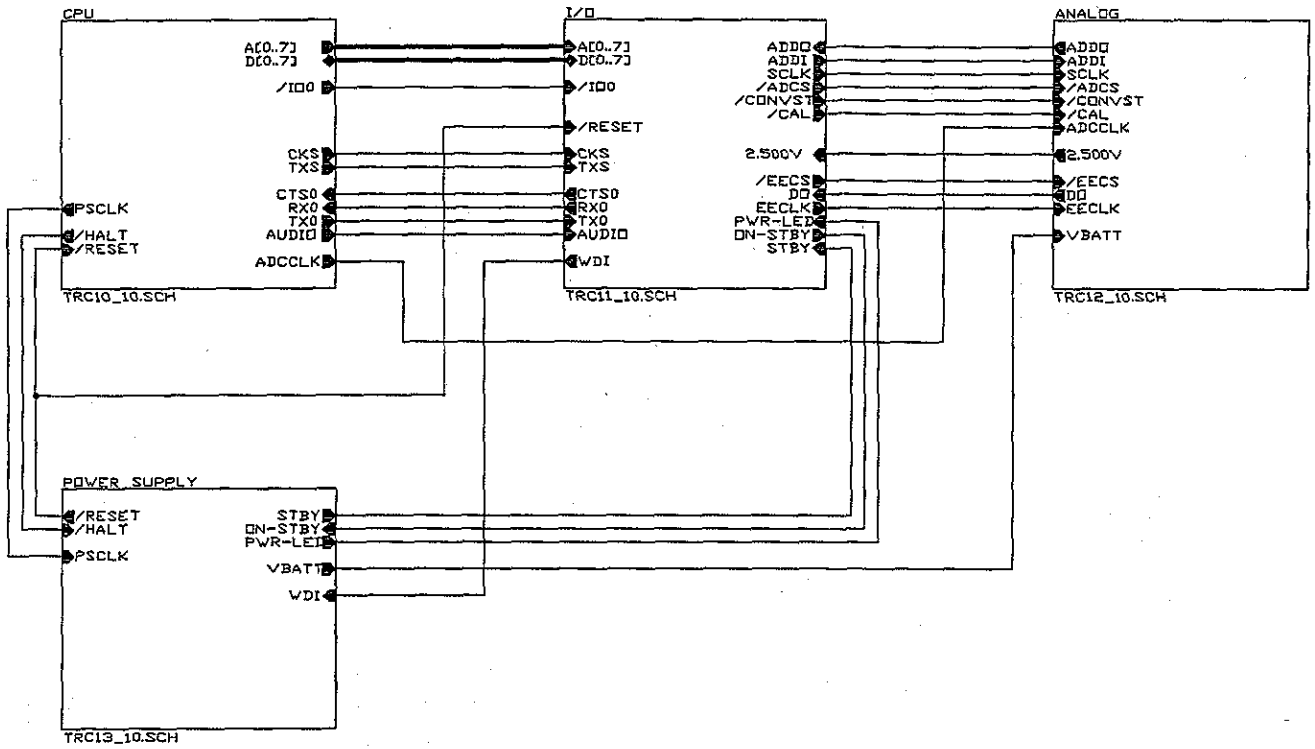
		MFG. APPR.: M.S.
		DATE: 1-22-97
MATERIAL:		TOLERANCE UNLESS OTHERWISE SPECIFIED: XX: ± .010 XXX: ± .005 ANGLES: ± 1°
FINISH:		
TITLE: PWB ASM MAIN BOARD - CO2 TRANSPORT		DRWG NO: 58502B1 REV. 4
		SHT. 2 OF 6

A-19



DRWG NO: 58502S1	
REV.	DESCRIPTION
1	SEE SHEET 4. C/N 4040 KMK 6-5-97

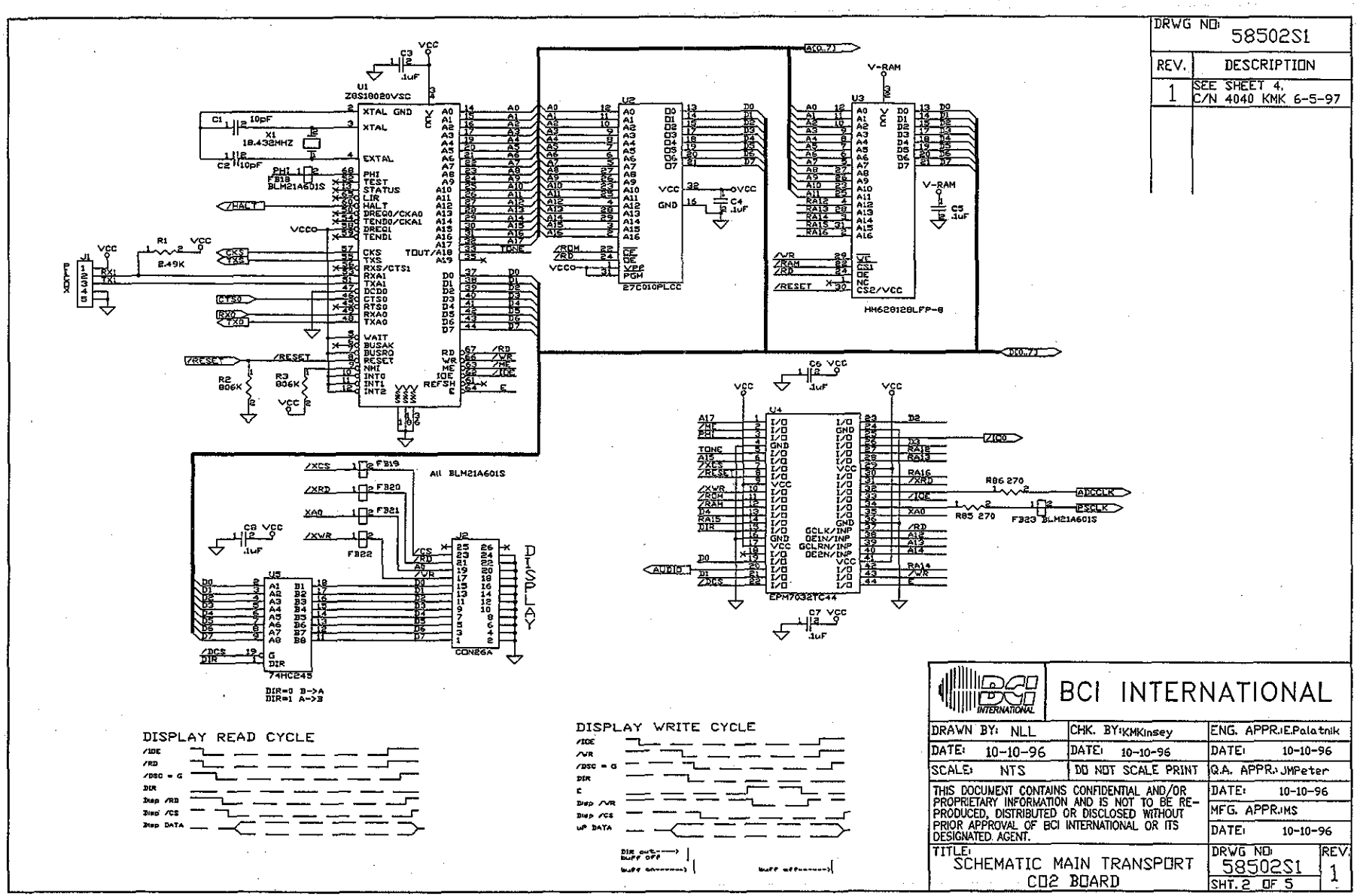
BCI INTERNATIONAL

DRAWN BY: NLL	CHK. BY: KMKinsey	ENG. APPR.: E.Palatnik
DATE: 10-10-96	DATE: 10-10-96	DATE: 10-10-96
SCALE: NTS	DO NOT SCALE PRINT	Q.A. APPR.: JMPeter
THIS DOCUMENT CONTAINS CONFIDENTIAL AND/OR PROPRIETARY INFORMATION AND IS NOT TO BE RE-PRODUCED, DISTRIBUTED OR DISCLOSED WITHOUT PRIOR APPROVAL OF BCI INTERNATIONAL OR ITS DESIGNATED AGENT.		DATE: 10-10-96
		MFG. APPR.: MS
		DATE: 10-10-96

TITLE:	DRWG NO:	REV.
SCHEMATIC MAIN TRANSPORT C02 BOARD	58502S1	1
	SHT. 1 OF 5	

ORIGINAL

A-20


DRWG NO: 58502S1
REV. DESCRIPTION
1 SEE SHEET 4. C/N 4040 KMK 6-5-97
U1 Z0S18020VSC
XTAL GND
XTAL
EXTAL
PHI
TEST
STATUS
LIR
HALT
DREQ0/CKA0
TEND0/CKA1
DREQ1
TEND1
CKS
TXS
RXS/CTS1
RXA1
TXA1
DCD0
CTS0
RTS0
RXA0
TXA0
WAIT
BUSAK
BUSRQ
RESET
NMI
INT0
INT1
INT2
RD
WR
ME
IOE
REFSH
TOUT/A18
TDNE
A19
C1 10pF
C2 10pF
X1 18.432MHZ
PHI FB18 BLM21A601S
/HALT
R1 2.49K
R2 806K
R3 806K
/RESET
CTS0
RXD
TXD
J1
U2 27C010PLCC
U3 HM628128LFP-8
V-RAM
C3 .1uF
C4 .1uF
C5 .1uF
C6 .1uF
C7 .1uF
C8 .1uF
A[0..7]
D[0..7]
U4 EPM7032TC44
R85 270
R86 270
F323 BLM21A601S
/IOE
/XRD
/XWR
XA0
/XCS
/XRD
XA0
/XWR
All BLM21A601S
U5 74HC245
DIR=0 B->A
DIR=1 A->B
J2 CON26A
DISPLAY
DISPLAY READ CYCLE
/IOE
/RD
/DSC = G
DIR
Disp /RD
Disp /CS
Disp DATA
DISPLAY WRITE CYCLE
/IOE
/WR
/DSC = G
DIR
E
Disp /WR
Disp /CS
uP DATA
BCI INTERNATIONAL
DRAWN BY: NLL
CHK. BY: KMKinsey
ENG. APPR.: E.Palatnik
DATE: 10-10-96
SCALE: NTS
DO NOT SCALE PRINT
Q.A. APPR.: JMPeter
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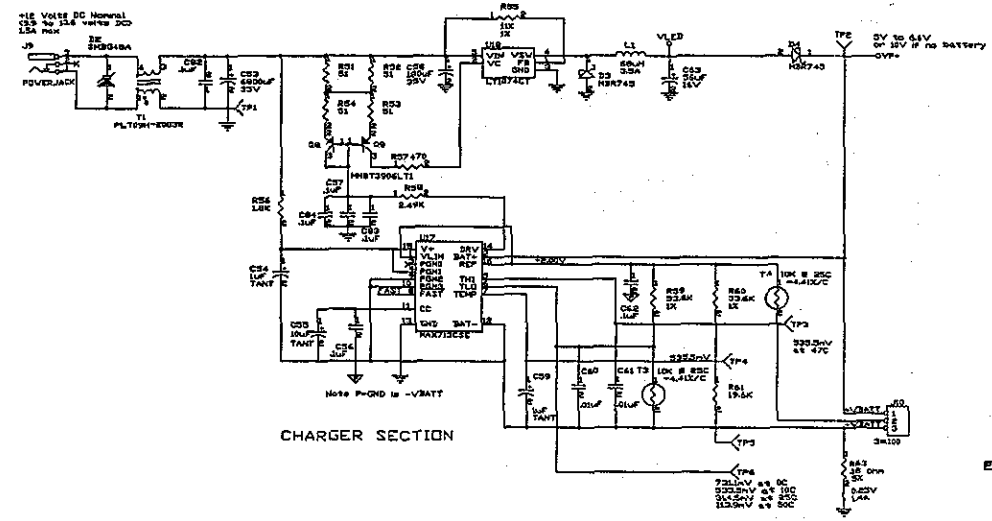
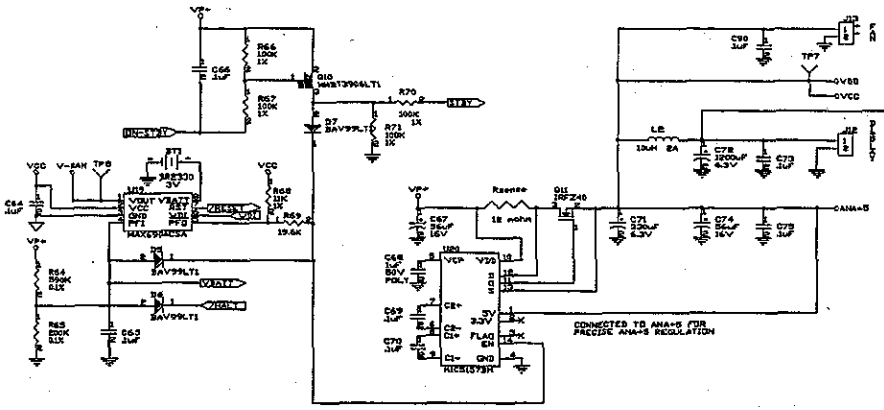
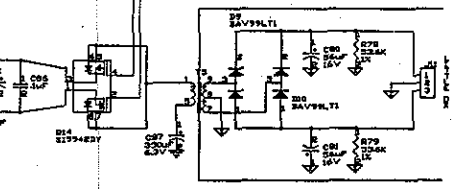
MFG. APPR.: MS
TITLE: SCHEMATIC MAIN TRANSPORT C02 BOARD
DRWG NO: 58502S1
REV: 1
SHT. 2 OF 5
ORIGINAL
A-21







DRWG NO: 58502S1	
REV.	DESCRIPTION
1	SEE SHEET 4. C/N 4040 KMK 6-5-97

BCI INTERNATIONAL

DRAWN BY: NLL	CHK. BY: KMKinsey	ENG. APPR.: E.Palatnik
DATE: 10-10-96	DATE: 10-10-96	DATE: 10-10-96
SCALE: NTS	DO NOT SCALE PRINT	Q.A. APPR.: JMPeter
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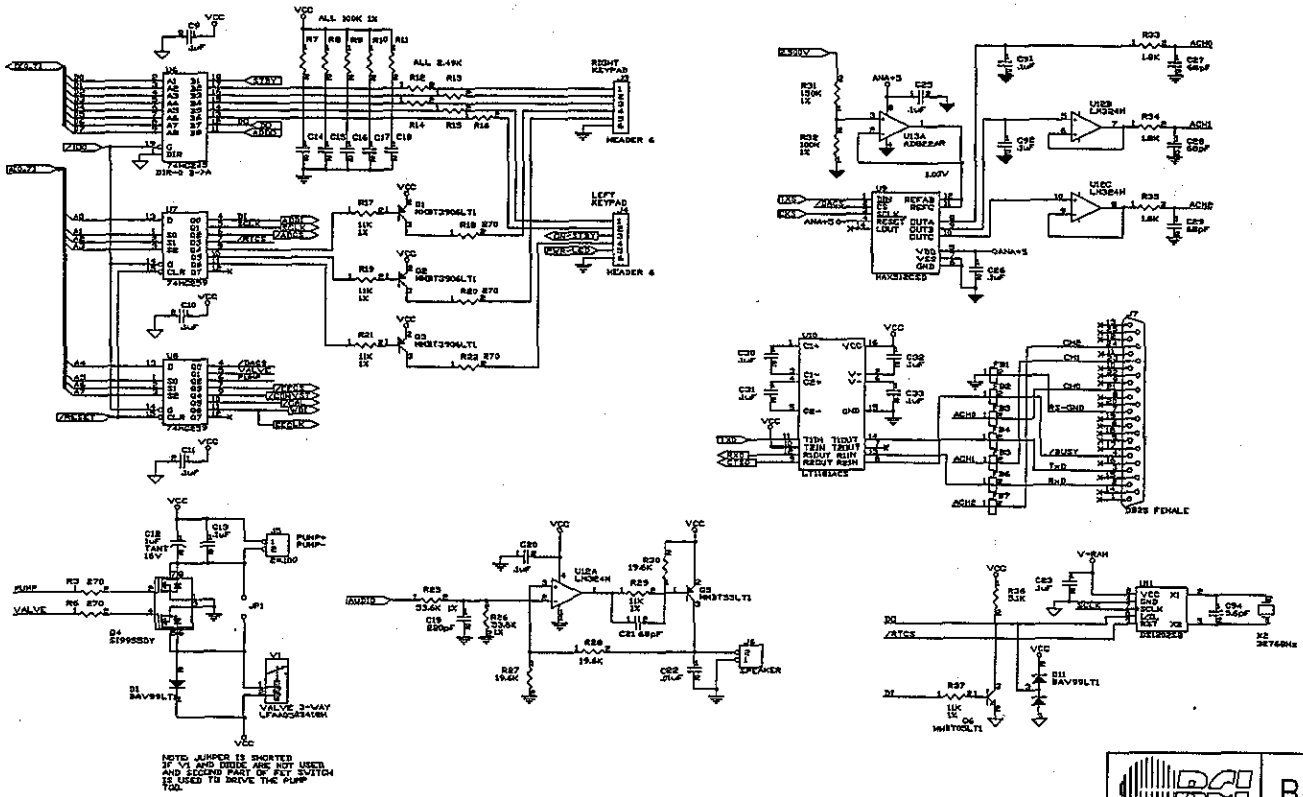
		MFG. APPR.: MS
		DATE: 10-10-96

TITLE:	DRWG NO:	REV.
SCHEMATIC MAIN TRANSPORT C02 BOARD	58502S1	1
	SHT. 3 OF 5	

ORIGINAL

A-22



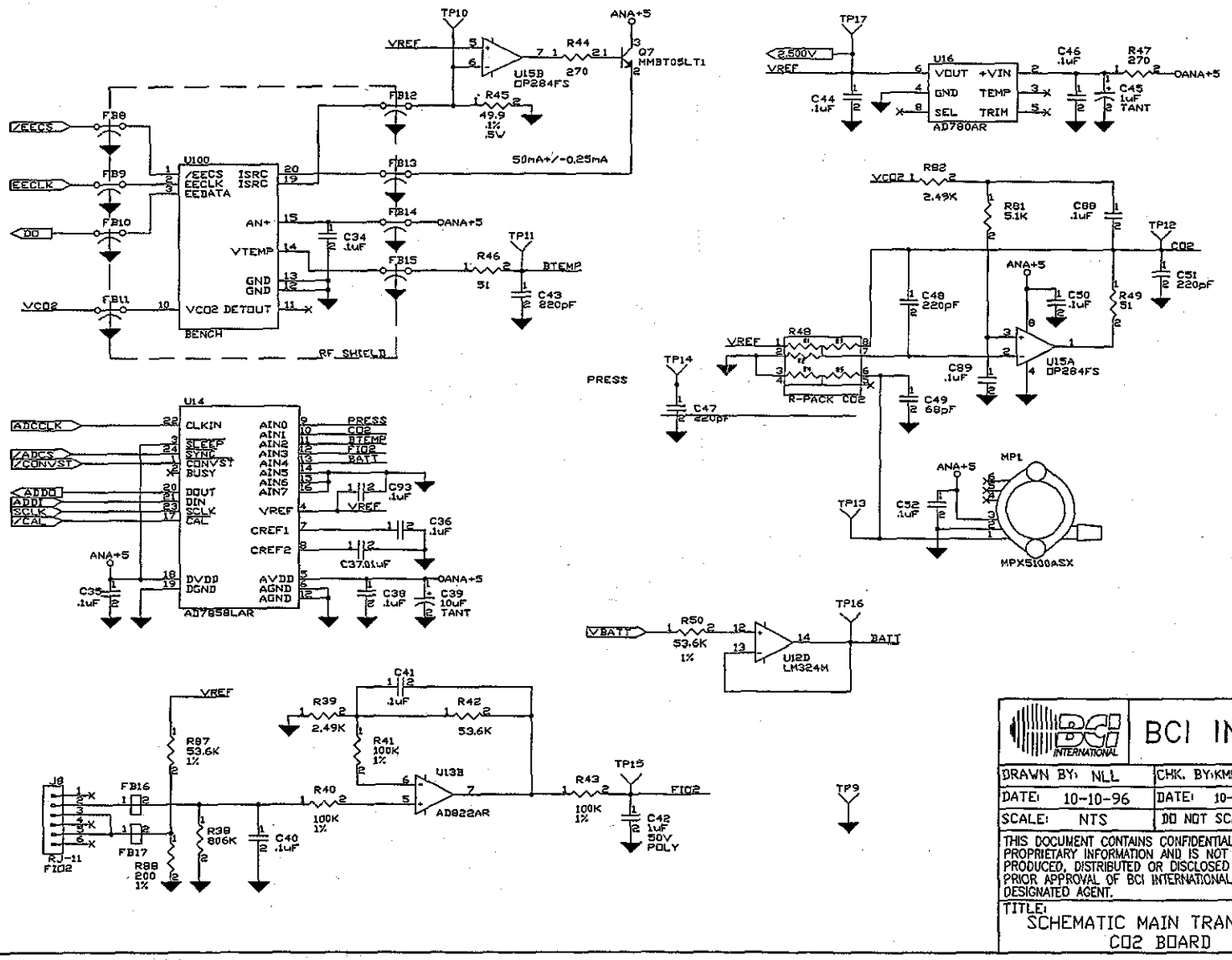
NOTE: JUMPER IS SHORTED IF V1 AND DIODE ARE NOT USED AND SECOND PART OF FET SWITCH IS USED TO DRIVE THE PUMP TOO.

DRWG NO: 58502S1	
REV.	DESCRIPTION
1	R31 WAS 464K. R32 WAS 11K. C/N 4040 KMK 6-5-97

BCI INTERNATIONAL		
DRAWN BY: NLL	CHK. BY: KMKinsey	ENG. APPR.: E.Palatnik
DATE: 10-10-96	DATE: 10-10-96	DATE: 10-10-96
SCALE: NTS	DO NOT SCALE PRINT	Q.A. APPR.: JMPeter
THIS DOCUMENT CONTAINS CONFIDENTIAL AND/OR PROPRIETARY INFORMATION AND IS NOT TO BE RE-PRODUCED, DISTRIBUTED OR DISCLOSED WITHOUT PRIOR APPROVAL OF BCI INTERNATIONAL OR ITS DESIGNATED AGENT.		DATE: 10-10-96
		MFG. APPR.: MS
		DATE: 10-10-96
TITLE: SCHEMATIC MAIN TRANSPORT CO2 BOARD		DRWG NO: 58502S1 REV. 1
		SHT. 4 OF 5

ORIGINAL

A-23



DRWG NO: 58502S1	
REV.	DESCRIPTION
1	SEE SHEET 4. C/N 4040 KMK 6-5-97

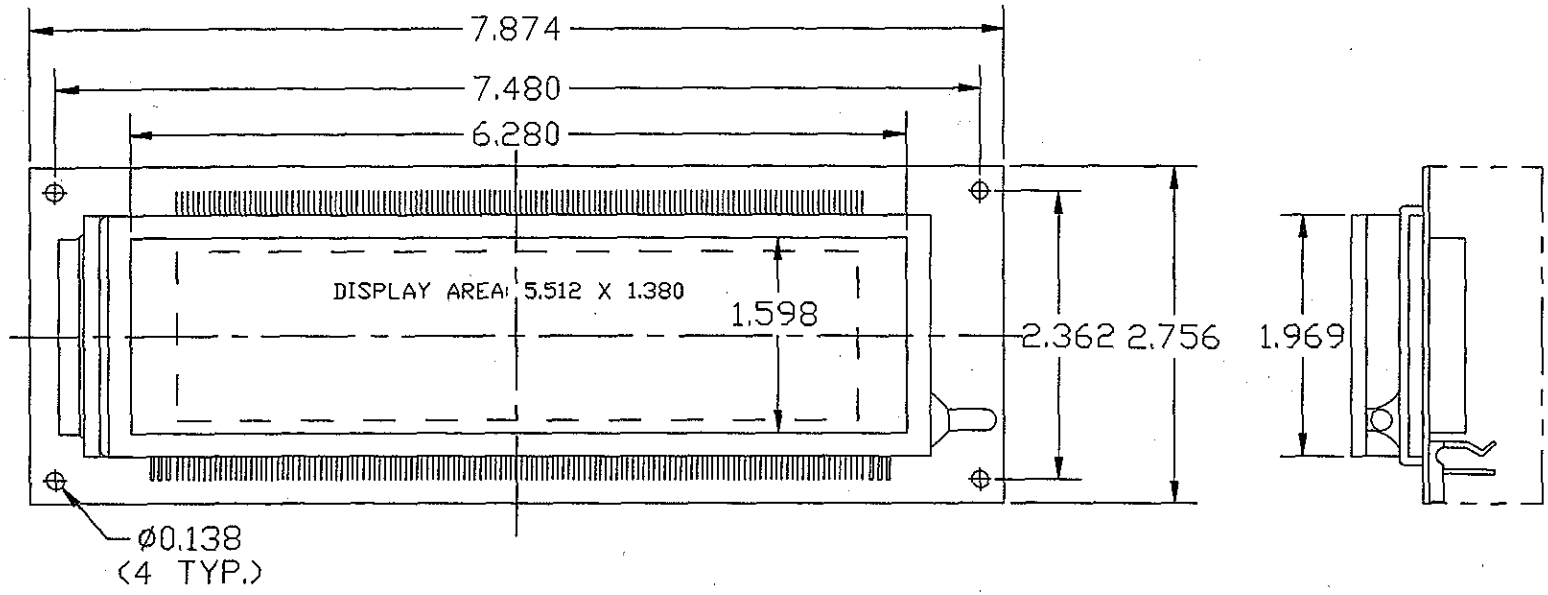
BCI INTERNATIONAL

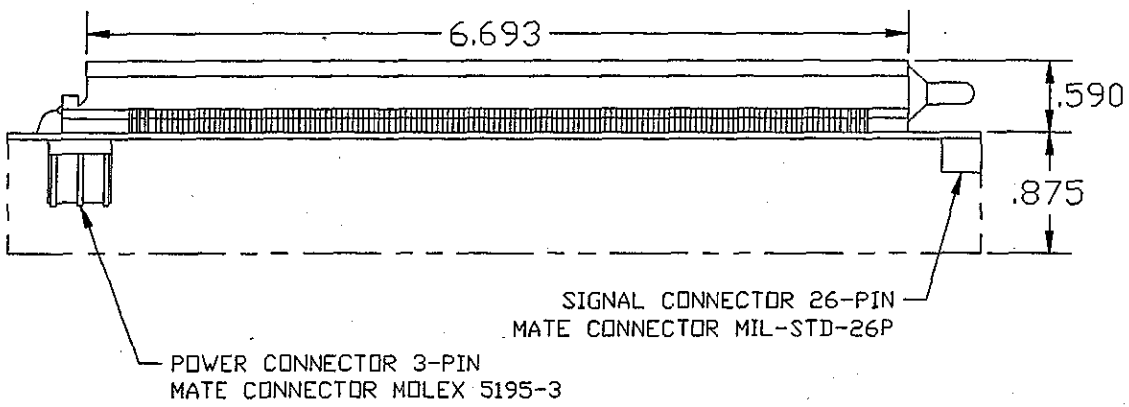
DRAWN BY: NLL	CHK. BY: KMKinsey	ENG. APPR.: E.Palatnik
DATE: 10-10-96	DATE: 10-10-96	DATE: 10-10-96
SCALE: NTS	DO NOT SCALE PRINT	Q.A. APPR.: JMPeter
THIS DOCUMENT CONTAINS CONFIDENTIAL AND/OR PROPRIETARY INFORMATION AND IS NOT TO BE RE-PRODUCED, DISTRIBUTED OR DISCLOSED WITHOUT PRIOR APPROVAL OF BCI INTERNATIONAL OR ITS DESIGNATED AGENT.		DATE: 10-10-96
		MFG. APPR.: MS
		DATE: 10-10-96
TITLE: SCHEMATIC MAIN TRANSPORT CO2 BOARD		DRWG NO: 58502S1 REV. 1
		SHT. 5 OF 5

ORIGINAL

A-24

DRWG NO: 58520B1	
REV.	DESCRIPTION





APPROVED MANUFACTURER:
ISE ELECTRONICS CORP. GU256X64-332A

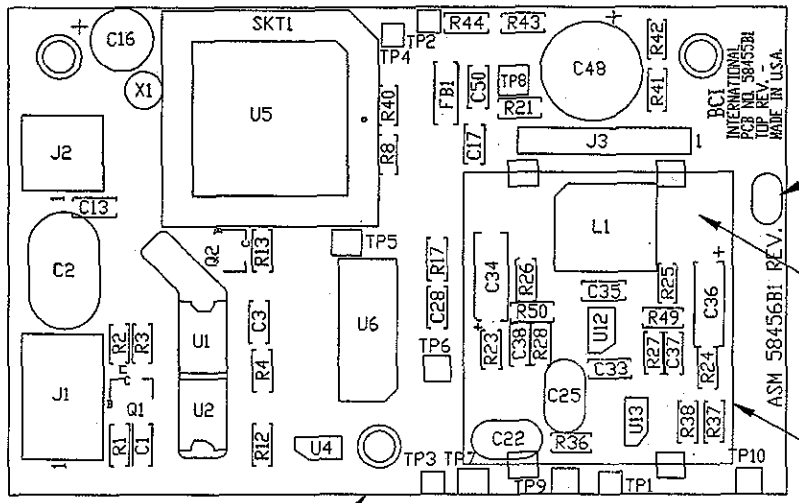
BCI INTERNATIONAL

DRAWN BY: BAE	CHK. BY:	ENG. APPR.
DATE: 11/27/95	DATE: 11-28-95	DATE: 11/28/95
SCALE: NTS	DO NOT SCALE PRINT	Q.A. APPR.
THIS DOCUMENT CONTAINS CONFIDENTIAL AND/OR PROPRIETARY INFORMATION AND IS NOT TO BE REPRODUCED, DISTRIBUTED OR DISCLOSED WITHOUT PRIOR APPROVAL OF BCI INTERNATIONAL INC. OR ITS DESIGNATED AGENT.		DATE: 11-28-95
		MFG. APPR.
		DATE: 11-28-95
MATERIAL:		TOLERANCE UNLESS OTHERWISE SPECIFIED: XX: ±.020 XXX: ±.005 ANGLES: ±1°
FINISH:		
TITLE: DISPLAY VACUUM FLUORESCENT GRAPHIC		DRWG NO: 58520B1 REV: 0
		SHT. 1 OF 1

A-25

ORIGINAL

TOP VIEW



ITEM 400

USING A PERMANENT MARKER MARK HERE WITH CURRENT REVISION.

ITEM 403 PASTED INSIDE THE TOP OF ITEM 402.

ITEM 402

DRWG NO: 58456B1	
REV.	DESCRIPTION
B	REMOVED C46 & C47 FROM SILKSCREEN, MOVED TP10 & R17, ADDED R49, R50, FAB & ASM NOS. .15" TO PWB LENGTH, "J3" WAS 103321-7 AMP. RJR 12-18-95
C	PG3 .1uF 50V 20% WAS 10%, 0805 Z5U SMT WAS X7R, MMBTA05LT1 WAS MMBT05LT1, AND 2.15K 1% WAS 5%. RJR 12-20-95
D	ON SHT 3 - C28 WAS 0805 & C48 WAS ECA-1AFQ4715. RJR 01-17-96
E	REVISED NOTE 3, SHT3 C28 WAS 1206, ADDED MOTOROLA AND INT'L REC. TO Q1-6. RJR 01-18-96
0	PRODUCTION RELEASE. RJR 01-18-96
1	ADDED ALT. PART TO D1, D2, Q3, & U7. C/N 2440 SDP 4/22/96
2	ADDED ALT. PARTS TO Q4, & Q5. EAR 1570 SDP 5/17/96
3	ADDED ITEM'S 402, 403 & SOCKET 1. C/N #2611 SDP 6/13/96
4	J1 WAS 22-14-2054 J2 WAS 22-14-2034 C/N #2901 CLL 1/31/97
5	J1 WAS 22-17-2062 J2 WAS 22-17-2042 C/N #3049 KMK 4-11-97
6	SEE SHEET 2. C/N #4059 MER 6-19-97
7	ECU-V1H102JCX WAS ECU-V1H102JCH, SHEET 3. C/N #4072 MER 6-27-97

SHEET 3-4 "V" SIZE (BOM)

NOTE:

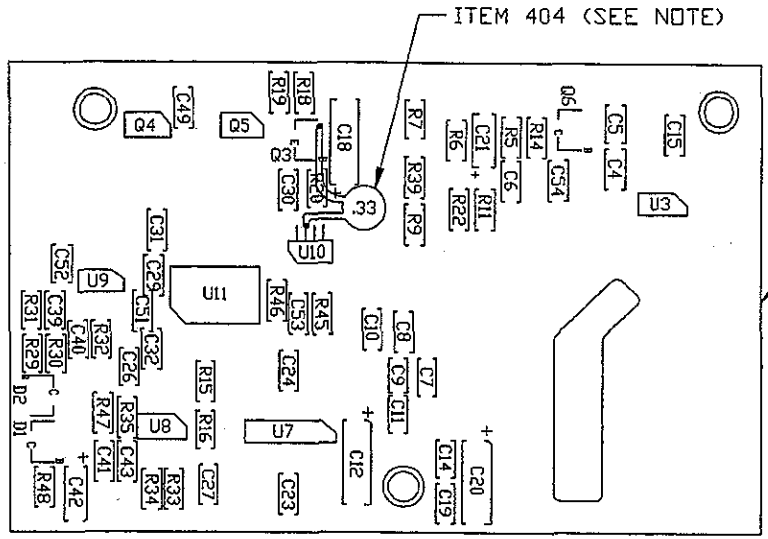
1) MANUFACTURER TO PLACE A "MFD BY" IDENTIFICATION MARK ON BOARD.
2) IF MANUFACTURER TESTS BOARDS, A TEST STAMP MUST BE PLACED ON THE BOARD INDICATING IT PASSED ALL TESTS.
3) VENDOR IS TO BUY, PROGRAM AND INSTALL uCONTROLLER (U5) PER SOFTWARE ASSEMBLY ITEM 401.

BCI INTERNATIONAL

DRAWN BY: RJR	CHK. BY: SCS	ENG. APPR: M.S.Geisler
DATE: 11-24-95	DATE: 1-18-96	DATE: 1-19-96
SCALE: NTS	DO NOT SCALE PRINT	Q.A. APPR: D.Siefert
		DATE: 1-19-96
		MFG. APPR: Ann M. Johnson
		DATE: 1-19-96
MATERIAL:		TOLERANCE UNLESS OTHERWISE SPECIFIED: XX: ±.010 XXX: ±.005 ANGLES: ±1°
FINISH:		
TITLE: PWB ASM OXIMETER BOARD - NIBP/CO2 TRANS.	DRWG NO: 58456B1	REV. 7
	SHT. 1 OF 4	

A-26

ORIGINAL



BOTTOM VIEW

NOTE: SOLDER LEADS BETWEEN PIN 7-U10, & Q3, R18, R19, U10 PIN 6 NODE.

DRWG NO: 58456B1

REV.	DESCRIPTION
B	COMPONENT LAYOUT WAS REVISED, ADDED C53, C54, R45, R46, R47, R48, D1, D2 AND Q6. RJR 12-18-95
C	SEE SHEET 1 FOR CHANGES. RJR 12-20-95
D	CORRECTED R53 TO R35. RJR 01-17-96
E	NO CHANGE THIS PAGE. RJR 01-18-96
0	PRODUCTION RELEASE. RJR 01-18-96
1	ADDED ALT. PART TO D1, D2, Q3, & U7. C/N 2440 SDP 4/22/96
2	SEE SHEET 1. EAR 1570 SDP 5/17/96
3	SEE SHEET 1. C/N #2611 SDP 6/13/96
4	SEE SHEET 1. C/N #2901 CLL 1/31/97
5	SEE SHEET 1. C/N 3049 KMK 4-11-97
6	ADDED ITEM 404 & NOTE. C/N 4059 MER 6-19-97
7	SEE SHEET 1. C/N 4072 MER 6-27-97

ORIGINAL

BCI INTERNATIONAL

DRAWN BY: RJR	CHK. BY: SCS	ENG. APPR.: M.S.Geisler
DATE: 11-24-95	DATE: 1-18-96	DATE: 1-19-96
SCALE: NTS	DO NOT SCALE PRINT	Q.A. APPR.: D.Siefert
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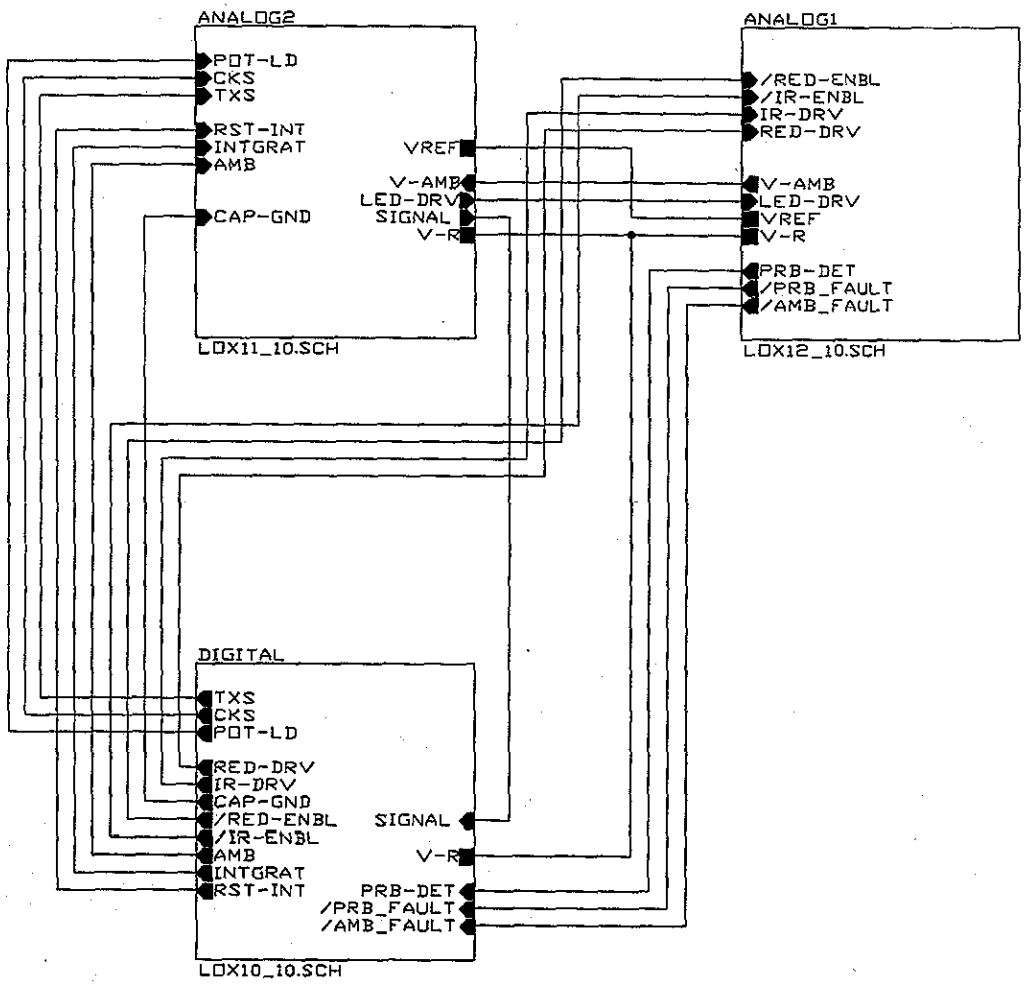
		MFG. APPR.: Ann M. Johnson
		DATE: 1-19-96
MATERIAL:		TOLERANCE UNLESS OTHERWISE SPECIFIED: XX: ±.010 XXX: ±.005 ANGLES: ±1°
FINISH:		
TITLE: PWB ASM OXIMETER BOARD - NIBP/CO2 TRANS.	DRWG NO: 58456B1	REV. 7
	SHT. 2 OF 4	

A-27



DRWG NO: 58456S1	
REV.	DESCRIPTION
B	NO CHANGE THIS PAGE. RJR 12-18-95
C	NO CHANGE THIS PAGE. RJR 12-20-95
0	PRODUCTION RELEASE. RJR 01-18-96

ORIGINAL

BCI INTERNATIONAL

DRAWN BY: RJR	CHK. BY: SCB	ENG. APPR.: 1-19-96
DATE: 10-31-95	DATE: 1/18/96	DATE:
SCALE: NTS	DO NOT SCALE PRINT	Q.A. APPR.: DATE: 1-19-96
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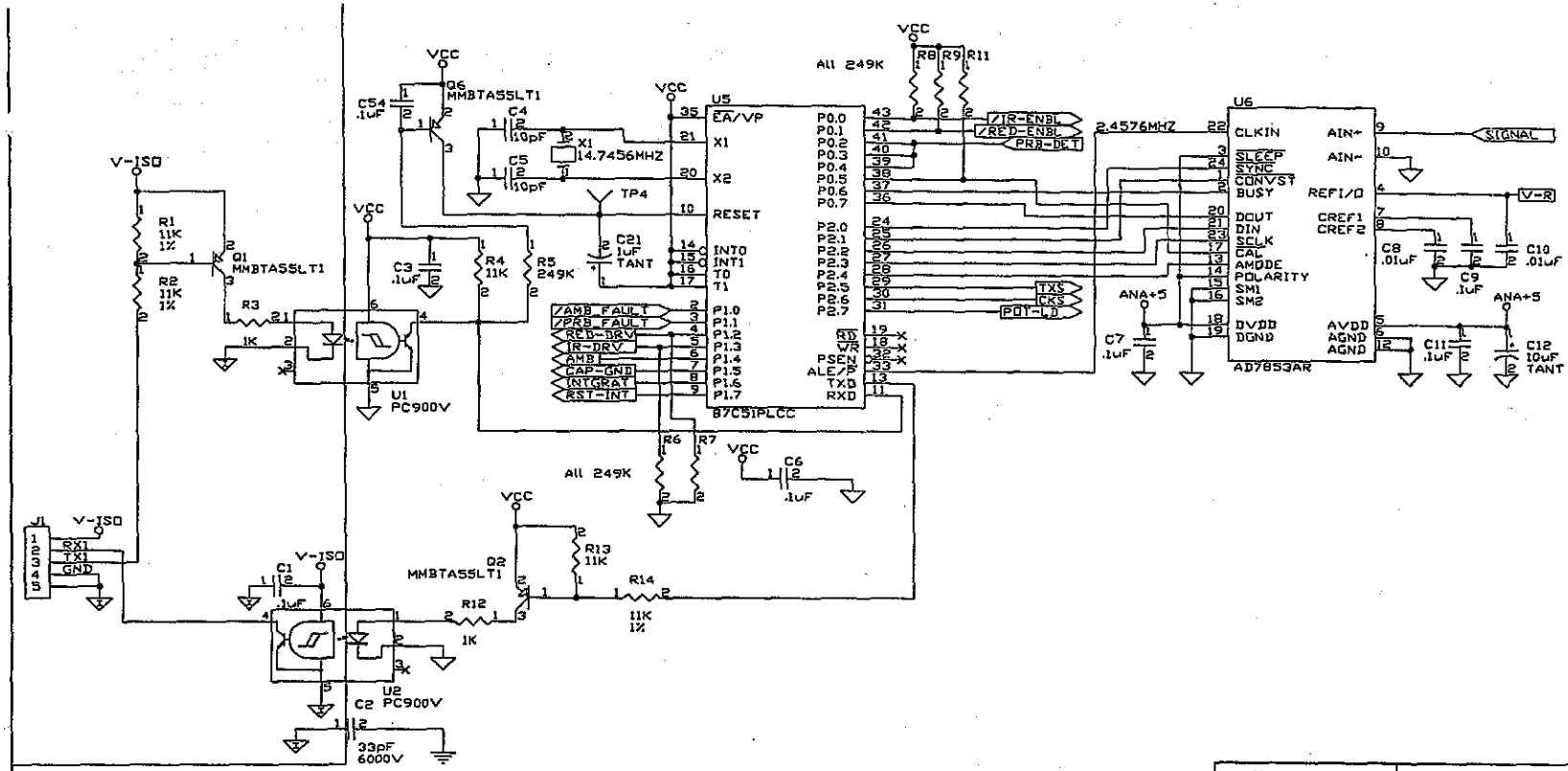
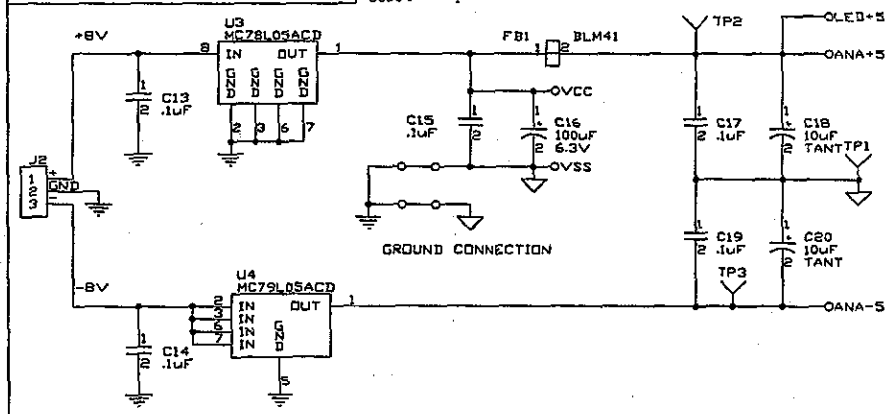
MATERIAL:		TOLERANCE UNLESS OTHERWISE SPECIFIED: XX: ±.010 XXX: ±.005 ANGLES: ±1°
FINISH:		
TITLE: SCHEMATIC OXIMETER BOARD NIBP	DRWG NO: 58456S1	REV. 0
	SHT. 1 OF 4	

A-20





ORIGINAL

DRWG NO: 58456S1	
REV.	DESCRIPTION
B	ADDED C54 AND Q6 FROM U5 PIN 10 TO R5 PIN. RJR 12-18-95
C	NO CHANGE THIS PAGE. RJR 12-20-95
0	PRODUCTION RELEASE. RJR 01-18-96

BCI INTERNATIONAL

DRAWN BY: RJR	CHK. BY: SCS	ENG. APPR.: 1-19-96
DATE: 10-31-95	DATE: 1/18/96	DATE:
SCALE: NTS	DO NOT SCALE PRINT	Q.A. APPR.: DATE: 1-19-96
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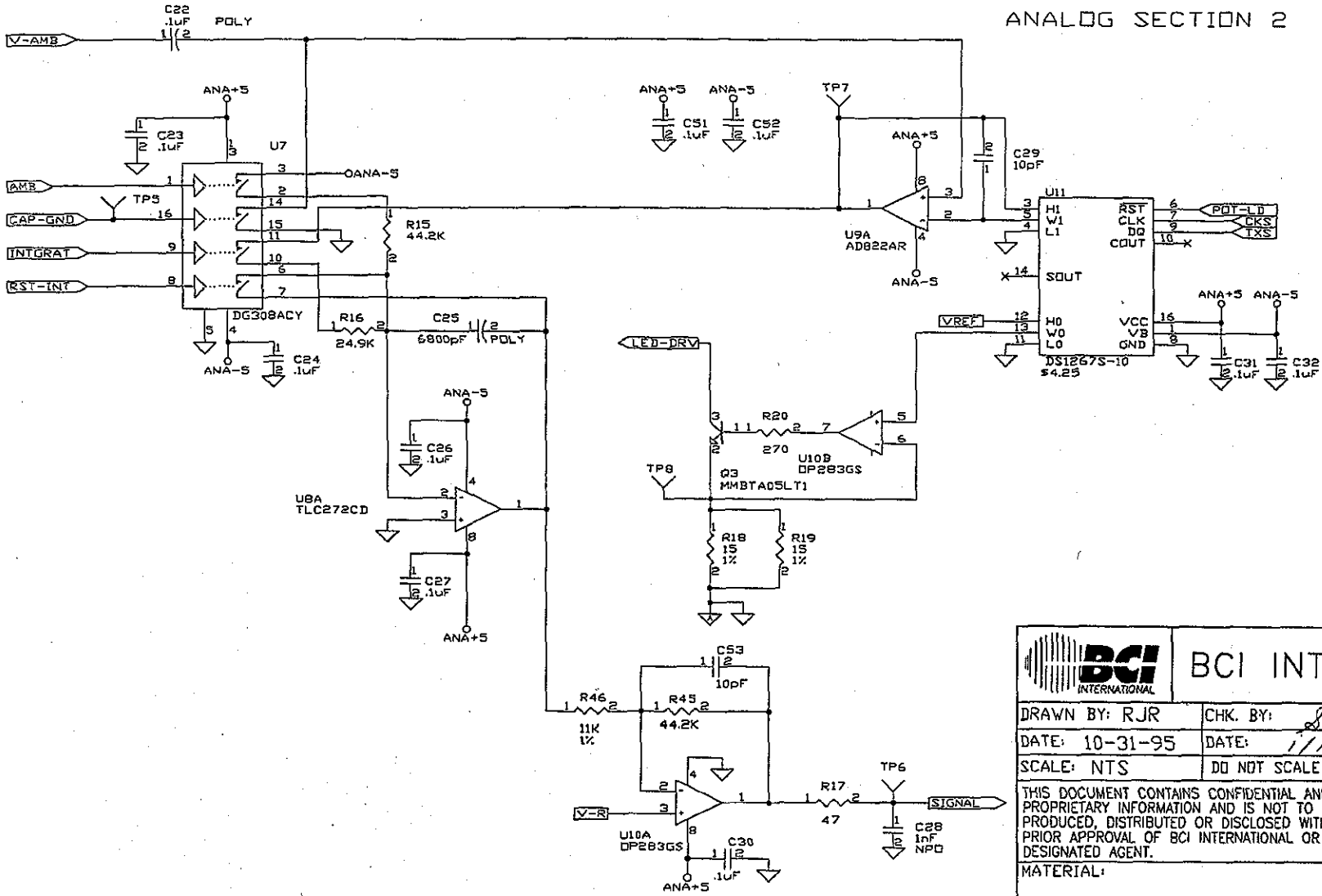
MATERIAL:		TOLERANCE UNLESS OTHERWISE SPECIFIED: XX: ±.010 XXX: ±.005 ANGLES: ±1°
FINISH:		
TITLE: SCHEMATIC OXIMETER BOARD NIBP		DRWG NO: 58456S1 REV. 0
		SHT. 2 OF 4

A-29

ANALOG SECTION 2



ORIGINAL

DRWG NO: 58456S1	
REV.	DESCRIPTION
B	"U9A" WAS OP283GS. RJR 12-18-95
C	"Q3" MMBTA05LT1 WAS MMBT05LT1. RJR 12-20-95
0	PRODUCTION RELEASE. RJR 01-18-96

BCI INTERNATIONAL

DRAWN BY: RJR	CHK. BY: SCS	ENG. APPR.: DATE: 1-19-96
DATE: 10-31-95	DATE: 1/18/96	DATE:
SCALE: NTS	DO NOT SCALE PRINT	Q.A. APPR.: DATE: 1-19-96
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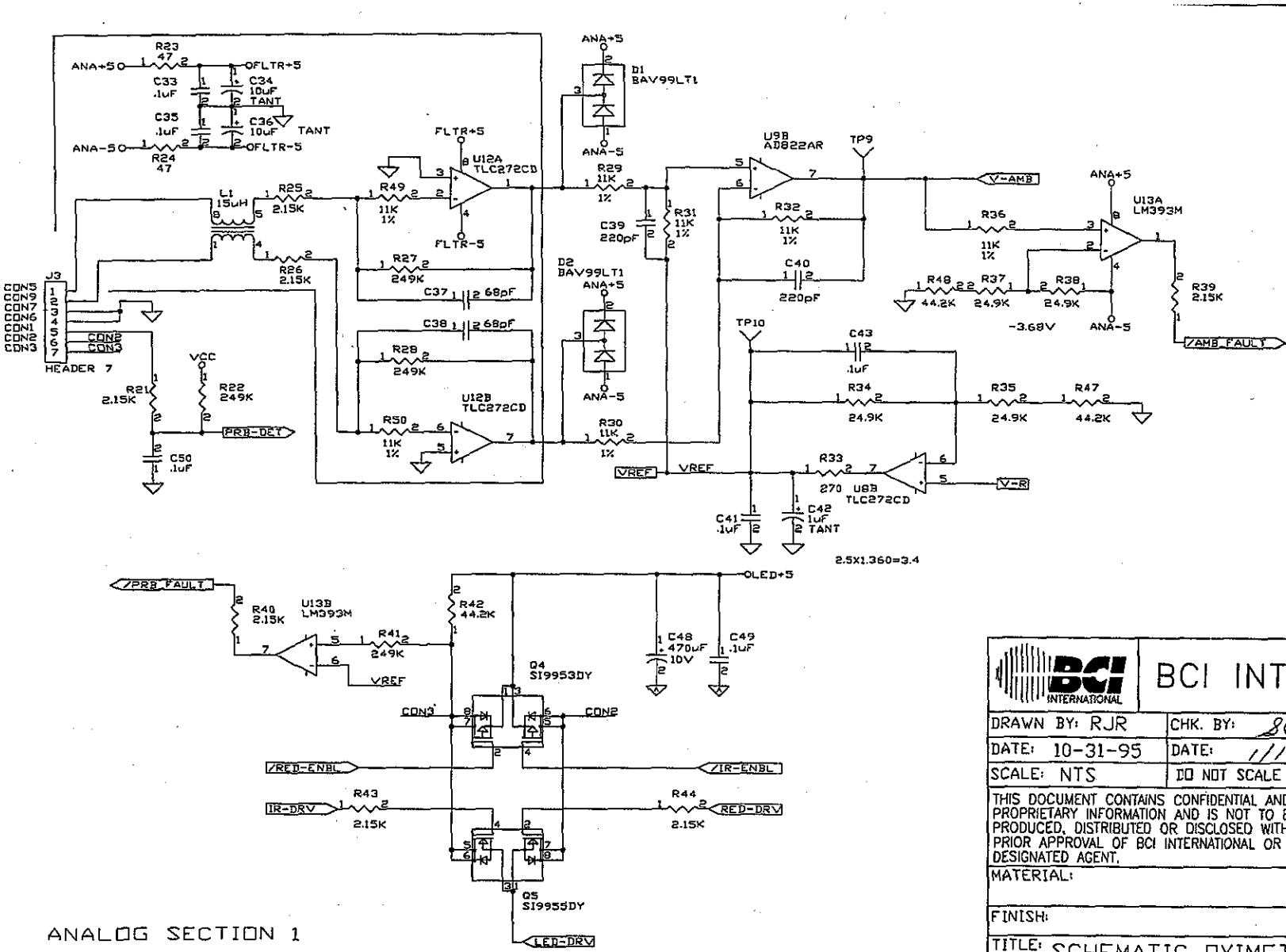
MATERIAL:		TOLERANCE UNLESS OTHERWISE SPECIFIED: XX: ±.010 XXX: ±.005 ANGLES: ±1°
FINISH:		
TITLE: SCHEMATIC OXIMETER BOARD NIBP		DRWG NO: 58456S1 REV. 0
		SHT. 3 OF 4

A-30



ANALOG SECTION 1

DRWG NO: 58456S1	
REV.	DESCRIPTION
B	'U9A' WAS DP283GS AND 'R42' WAS 249K. RJR 12-18-95
C	NO CHANGE THIS PAGE. RJR 12-20-95
0	PRODUCTION RELEASE. RJR 01-18-96

ORIGINAL

BCI INTERNATIONAL

DRAWN BY: RJR	CHK. BY: SC S	ENG. APPR.: 1-19-96
DATE: 10-31-95	DATE: 1/18/96	DATE:
SCALE: NTS	DO NOT SCALE PRINT	Q.A. APPR.:
THIS DOCUMENT CONTAINS CONFIDENTIAL AND/OR PROPRIETARY INFORMATION AND IS NOT TO BE RE-PRODUCED, DISTRIBUTED OR DISCLOSED WITHOUT PRIOR APPROVAL OF BCI INTERNATIONAL OR ITS DESIGNATED AGENT.		DATE: 1-19-96
		MFG. APPR.:
		DATE: 1/19/96
MATERIAL:		TOLERANCE UNLESS OTHERWISE SPECIFIED: XX: ±.010 XXX: ±.005 ANGLES: ±1°
FINISH:		
TITLE: SCHEMATIC OXIMETER BOARD NIBP	DRWG NO: 58456S1	REV. 0
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